JUNE
1961

ICE 75 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

INDUSTRIAL LIGHTING

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WEST GERMAN METHODS

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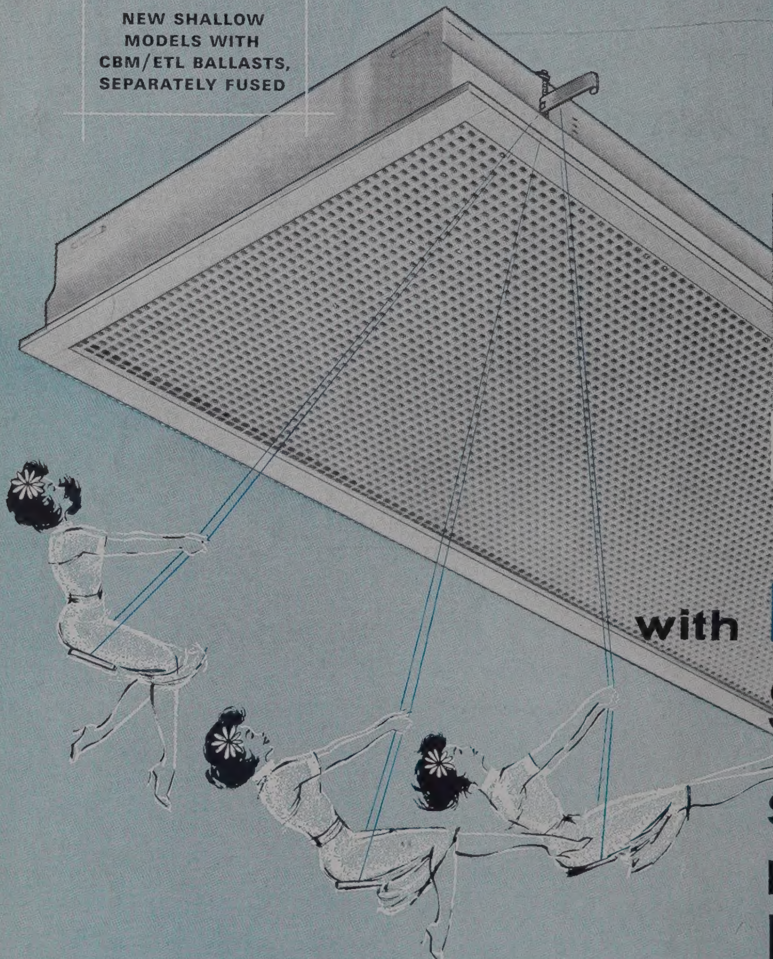
A McGRAW-HILL PUBLICATION | 60TH YEAR

GUTH saves up to 50% on Troffer installation*



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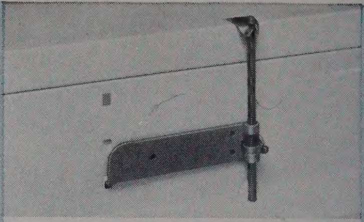

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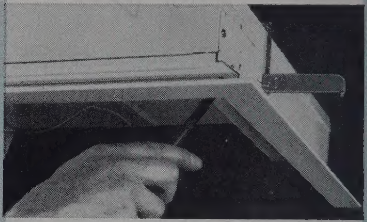
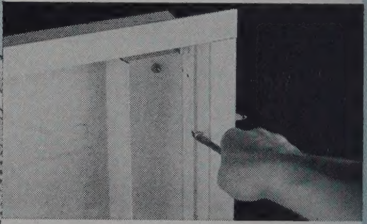


Release SMB by tripping clip from inside troffer. It's ready to hook over support.



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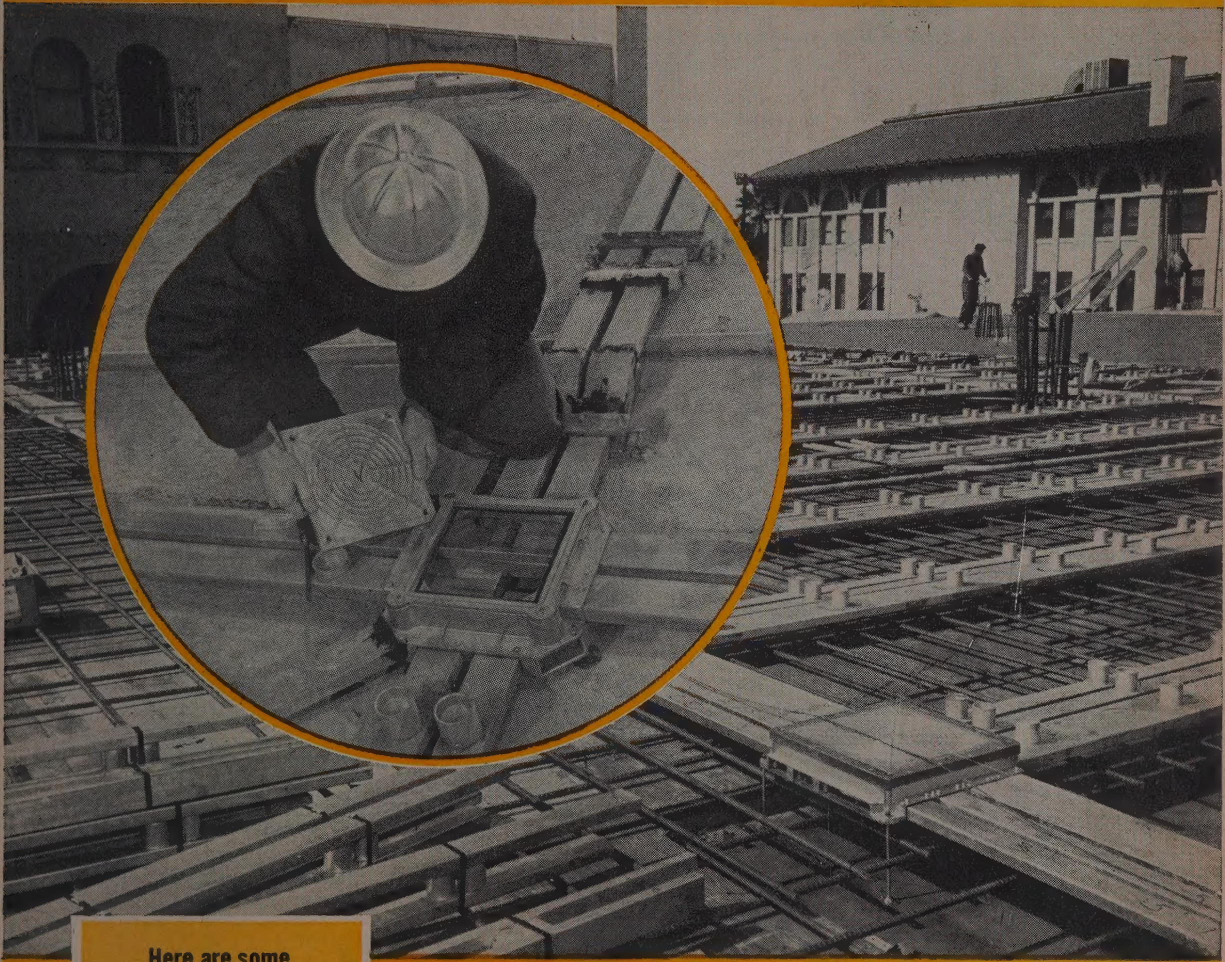

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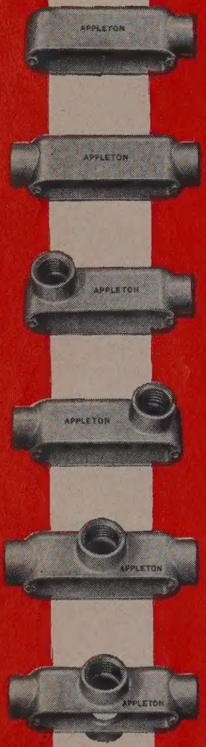

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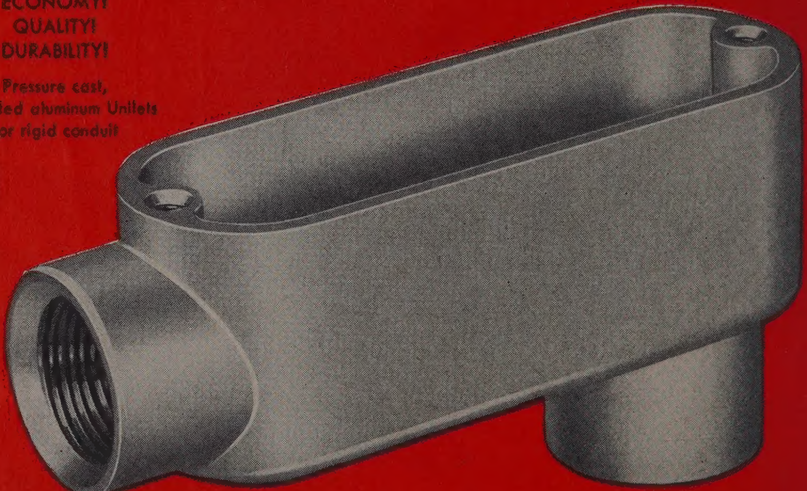

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MORE

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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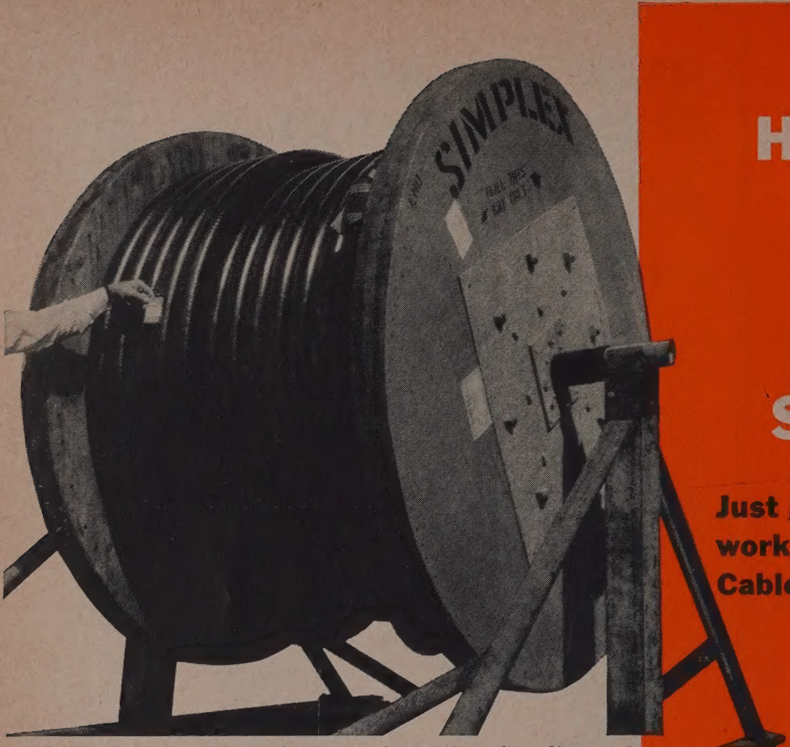

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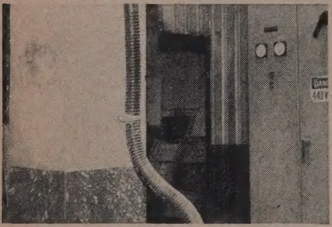

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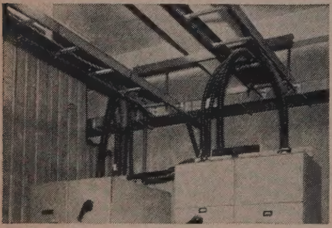

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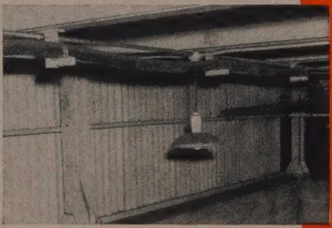

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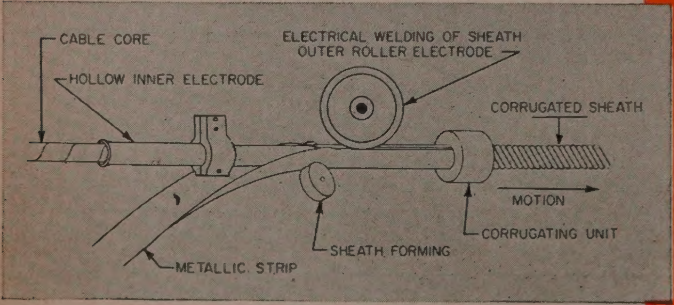

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Sidelights

ON-SITE GENERATION

A remarkable new energy system developed in the Southwest is being installed in several new buildings in Arkansas and Texas. Using natural gas, an array of gas-turbine engine-generator sets provide electric power for lights and motors while exhaust gases fire a low pressure steam system for heating, hot water and air conditioning requirements. For windowless commercial and institutional buildings the economics are said to be favorably competitive with purchased power. The systems are described in "Economical On-Site Electric Generation" by Dana Price, electrical engineer with Golemon & Rolfe, Architects and Engineers of Houston, Texas beginning on page 65.

PRACTICE IN WEST GERMANY

Similarities and differences of electrical installation practice in West Germany as compared with U. S. methods are noted by Editor W. T. Stuart from a recent visit to the modern manufacturing plants of Volkswagen in Wolfsburg and Hannover. "Highlights of Electrical Practice in West Germany" begins on page 69.

LIGHTING TOOLS

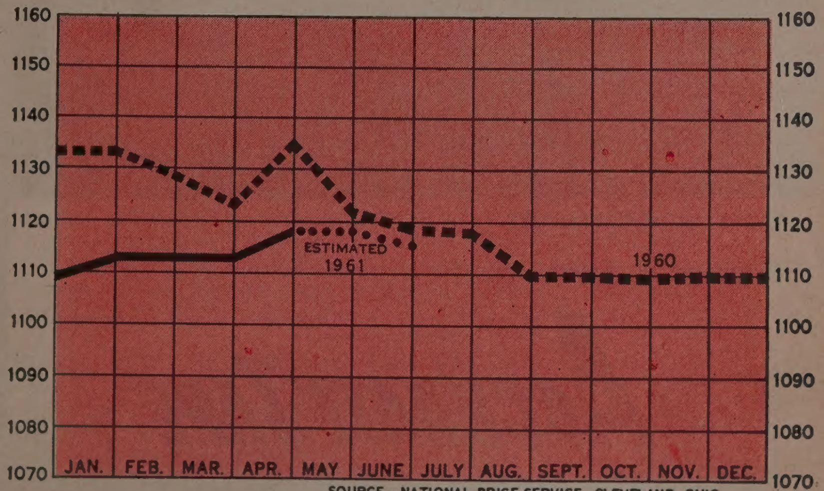
The broad range of fixtures and lamps applicable to industrial lighting applications today gives the lighting engineer a choice of lighting tools. In the selection of lighting systems many factors influence over-all lighting costs and the end quality of the lighting result obtained. Theodore Ake, application engineer, The Miller Co., describes and discusses these factors in "Use Today's Industrial Lighting Tools Intelligently" beginning on page 72.

COMPUTER WIRING

Many novel features are involved in the electrical systems installation for the National Cash Register Company's new data processing center in New York City. Wireways in a floating floor provide for the connections between the several distribution systems and the computer machines. Associate Editor J. F. McPartland describes the intricate system designed by Frank Aluisio, chief electrical engineer of Air Research Associates, consulting engineers, and installed by Arc Electrical Construction Co., in the article "Wireway Circuits Power Computers" beginning on page 78.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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Washington Report

JUNE • 1961

The business tempo quickened in May as the national economy turned upward from what is now being termed the mildest recession postwar. This recovery has started sooner, and is stronger, than was expected by government economists, most of whom now concede that a vigorous recovery may be underway. A $530 billion GNP pace by year's-end is considered as possible by Treasury Secretary Douglas Dillon, and Dr. Walter Heller, chairman of the Administration's Council of Economic Advisers, cautiously admits "an upturn may be in the making."

Evidence that the upturn is picking up steam is widespread, and includes gains in industrial production, personal income, factory orders, steel output, auto production, new construction, a longer work week, employment, retail sales, and others.

How far and how fast the recovery will go is now the big question. Business economists and businessmen comprising the Dept. of Commerce's Business Advisory Council, meeting in mid-May, predicted that the economic recovery will be a slow one, but said their diagnosis does not call for new Federal efforts to make the recovery go faster. Even so, the Administration and Congress are counting on new outlays for defense, space research and activity, education, and Federal grants for state and local public works.

Industrial production in May was 105% (FRB Index) of the 1957 base period, up from 102% in April. Average for the second quarter is expected to hit 104%, and to reach 110% in the 4th quarter, according to Commerce's Business Advisory Council.

Personal income rose to $410.3 billion (seasonally adjusted annual rate) in April, up from $408 billion in March, and up from $401.9 billion in April of 1960. This was $700 million more than the previous record of $409.6 billion in October 1960.

Cost-of-living held steady in March at the record level of 127.5% (of 1947-49 average), Labor Dept. reported. This is up 1.4% from March 1960, a year earlier.

New construction in April totaled $4,329 million, of which $3,013 million was with private funds and $1,316 million with public funds. Biggest gains over a year earlier were for office buildings, hotels and factories.

A speedup in distribution of highway construction funds was ordered by President Kennedy last month. Funds earmarked for rationing to states between July 1 and September 30, totaling $818 million, were released in May.

Business will spend over $35 billion for new plant and equipment during 1961, according to Dept. of Commerce-Securities Exchange Commission survey earlier this year, and recently verified by McGraw-Hill Economics Dept. capital spending survey. Spending, now increasing at an accelerating rate, is expected to hit an annual rate of $37.3 billion in the fourth quarter.

Housing starts in April were down 6% from March, on a seasonally adjusted annual rate, after having increased in each of the three previous months. This was 7% below the year-earlier level. But year-to-year comparisons will improve in the months ahead because of 1960's unimpressive record. Rental vacancy rates for the first quarter were 8% of available units, Commerce Dept. reported, up from 7.6% in 4th quarter of 1960.

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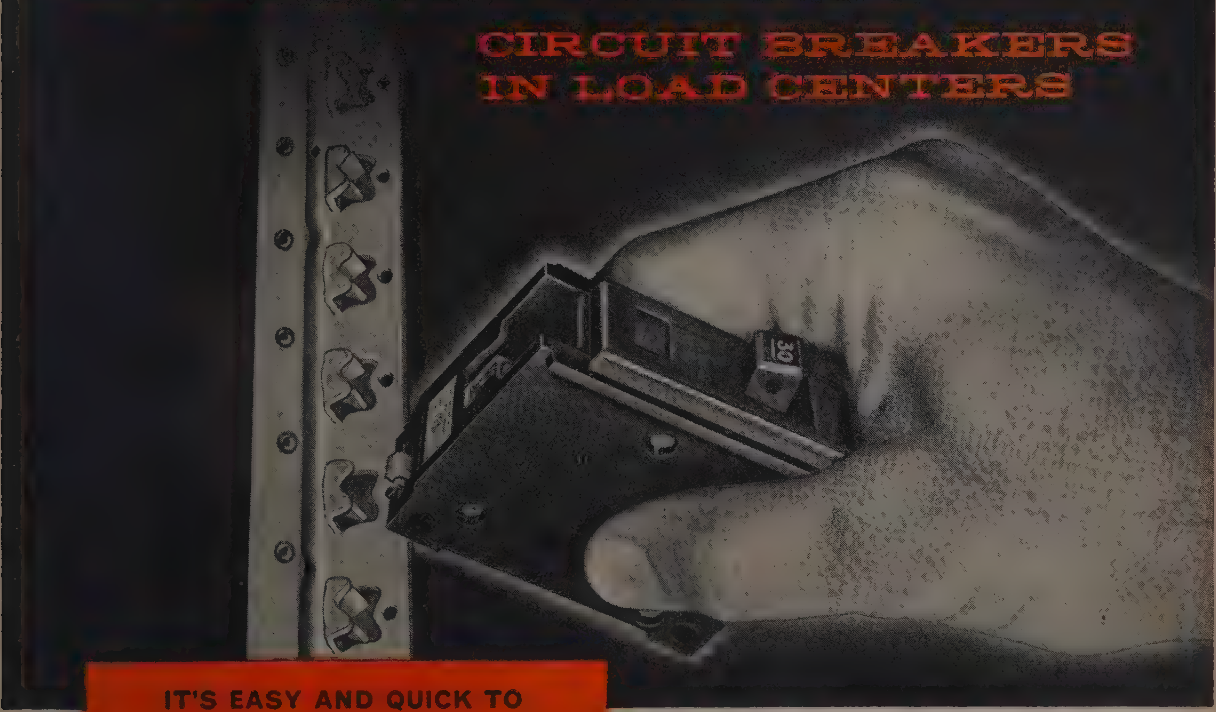
CIRCUIT BREAKERS IN LOAD CENTERS



IT'S EASY AND QUICK TO PREPARE Ⓕⓐ LOAD CENTERS FOR NON-INTERCHANGEABILITY

Removal of interference tabs in mounting back takes but a moment with simple tool furnished by Ⓕⓐ Distributor.

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Ratings: 15, 20, 30, 40, 50 and 70 amps.

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SIZE	NO. OF STRANDS	LIST PRICE	SIZE	NO. OF STRANDS	LIST PRICE	DOLLARS	PERCENTAG (Approx.)
6	7	$ 67.30	4	7	$ 54.10	$ 13.20	20%
2	7	137.00	1/0	19	109.00	28.00	20%
4/0	19	406.00	300 MCM	19	311.00	95.00	23%
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"We've been putting in concealed telephone wiring for five years...we know it helps sell houses"

say Ken Behling and Milo E. Schandelmeier, Jr. Brookside Builders, Inc., Elm Grove, Wisconsin

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"Telephone planning is as much the builder's responsibility as planning for electricity, ventilation and heating," adds Milo Schandelmeier. "We've put up about 250 homes here in the Milwaukee area. And for the past five years, all have been pre-planned for telephones. It's a sign of quality that gives our customers confidence in us."

* * *

Your local Bell Telephone Business Office will gladly help telephone-plan your homes. For details on home telephone installations, see Sweet's Light Construction File, 11c/Be. For commercial installations, Sweet's Architectural File, 34a/Be.

BELL TELEPHONE SYSTEM

Milo Schandelmeier (left) and Ken Behling discuss the advantages of concealed telephone wiring with Norman Quam (standing), a communications engineer with Wisconsin Bell Telephone Company. Milo and Ken are now installing convenient telephone outlets in every one of their homes at the Indianwood section of Elm Grove, Wisconsin.

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. . . speeds Limitamp control inspection and maintenance

Maintenance is an easy job with General Electric's draw-out Limitamp control. Routine maintenance is quickly performed with the contactor in place.

Coils and contact tips can be changed in minutes. Simply lift out the arc chutes and one arc horn to expose the bolts holding coils and tips in place.

To make your job still easier, a magnet-head wrench is supplied with units. This wrench fits all bolts necessary to change coils and tips. Remember . . . Limitamp control is all front connected.

To replace fuses, you just pull the ejector and the fuses pop up. When a fuse is replaced, it is guided into position by a back-stop on the clip.

Another feature is a special test circuit—built into each control. Bring in external power and connect it to the terminal board. You can then safely operate the panel—automatically isolated from normal power source with the door open—to check out the unit before putting it in service.

Ask your G-E Sales Engineer or Agent about other advanced-design maintenance, installation, operation, and performance features of Limitamp control. Or, write Section 783-25, General Electric Co., Schenectady, N. Y. for Bulletin GEA-6893. Industry Control Dept., Salem, Va.

* Reg. Trade-mark of General Electric Company.

Progress Is Our Most Important Product

GENERAL ELECTRIC

FAST

call your electrical distributor for fast delivery of Youngstown conduit —most complete conduit line

Youngstown conduit is a winding, twisting, reaching raceway in today's most modern buildings. It is familiar, reliable steel conduit. Easier to cut, thread, bend, install, fish. And you get it fast, where you need it, from your electrical distributor.

Youngstown makes conduit in the exact size and finish you need. Buckeye is carbon steel for standard installations. Yoloy is alloy steel to resist corrosion. Sizes: ½″ to 4″ are Youngstown continuous weld pipe. Sizes 5″ and 6″ are standard weight Youngstown seamless pipe. Ask for Hot Galvanized conduit, with hot galvanized threads that need no special lubrication. Choose smooth finish Electro Galvanized conduit. Black Enameled conduit. Or easy-to-handle, lightweight EMT.

Youngstown rigid steel conduit and EMT are sold through electrical distributors. Their stocks are complete. They are the best in their field, picked by Youngstown for reputation, knowledge, service and dependability. They offer you fast, on-time delivery of quality conduit from Youngstown, largest producer of steel conduit in the world.

Youngstown — growing force in steel

For Information about Youngstown Steel Conduit, write: Dept. 26-C,
The Youngstown Sheet and Tube Company, Youngstown, Ohio

FULL-VALUE
CERTIFIED
TRANSFORMER
GENERAL ELECTRIC

- Superior design, features, and performance
- Faster shipment
- Complete service

NEW seale
gas coolan

SYMBOL OF FULL VALUE

With this seal, General Electric certifies full value for your transformer dollar; full value in terms of superior basic design, features, and performance . . . plus faster order handling and shipment . . . plus complete service before, during, and after installation. No other transformer manufacturer can match this complete General Electric package.

dry-type transformers feature for higher insulation levels

General Electric gas-filled units are as much as 30 percent lighter, smaller than previous designs

Use of a new gas—C_3F_8 (Perfluoropropane)—improves heat-transfer characteristics, increases insulation levels, and permits reduction in size and weight of General Electric 15-kv and below sealed dry-type transformers. This new gas has all desirable features of previously used nitrogen . . . plus these added advantages:

- Basic impulse insulation level is significantly higher for all ratings—up to 90 percent above dry-type standards for the 15-kv class.
- Higher insulating properties of C_3F_8 permit size (and, therefore, weight) reduction of sealed dry-type transformers.
- Extremely stable under normal operating conditions, C_3F_8 is non-toxic and non-flammable.

Plus proved construction features

Alpholite* insulation—Inorganic, non-aging, and non-combustible, this insulation has high mechanical and dielectric strength.

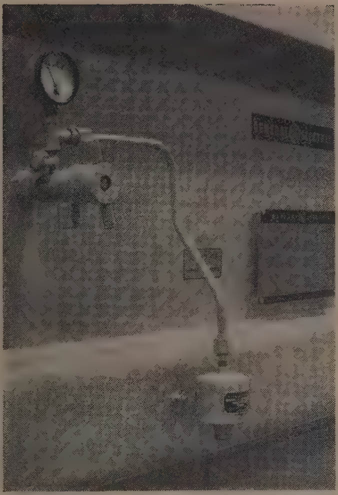
Silicone impregnation of entire core-and-coil structure improves short-circuit strength.

All-welded internal connections give "continuous conductor" construction, eliminate loosening of joints by normal heat cycling.

Terretex high-voltage insulation—This refined, inorganic asbestos material is impregnated with acrylic-ester resin and bound with glass wrap.

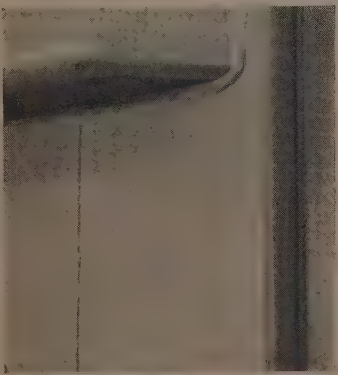
For more information on superior General Electric gas-filled sealed dry-type transformers, contact your General Electric Sales Engineer or Agent. General Electric Co., Schenectady, N.Y.

*Trade-mark of General Electric Company. 417-11



ACCESSORIES include pressure gage, over-, under-pressure device, and diagrammatic nameplate.

HERMETICALLY SEALED BUSHINGS provide more positive tank seal.



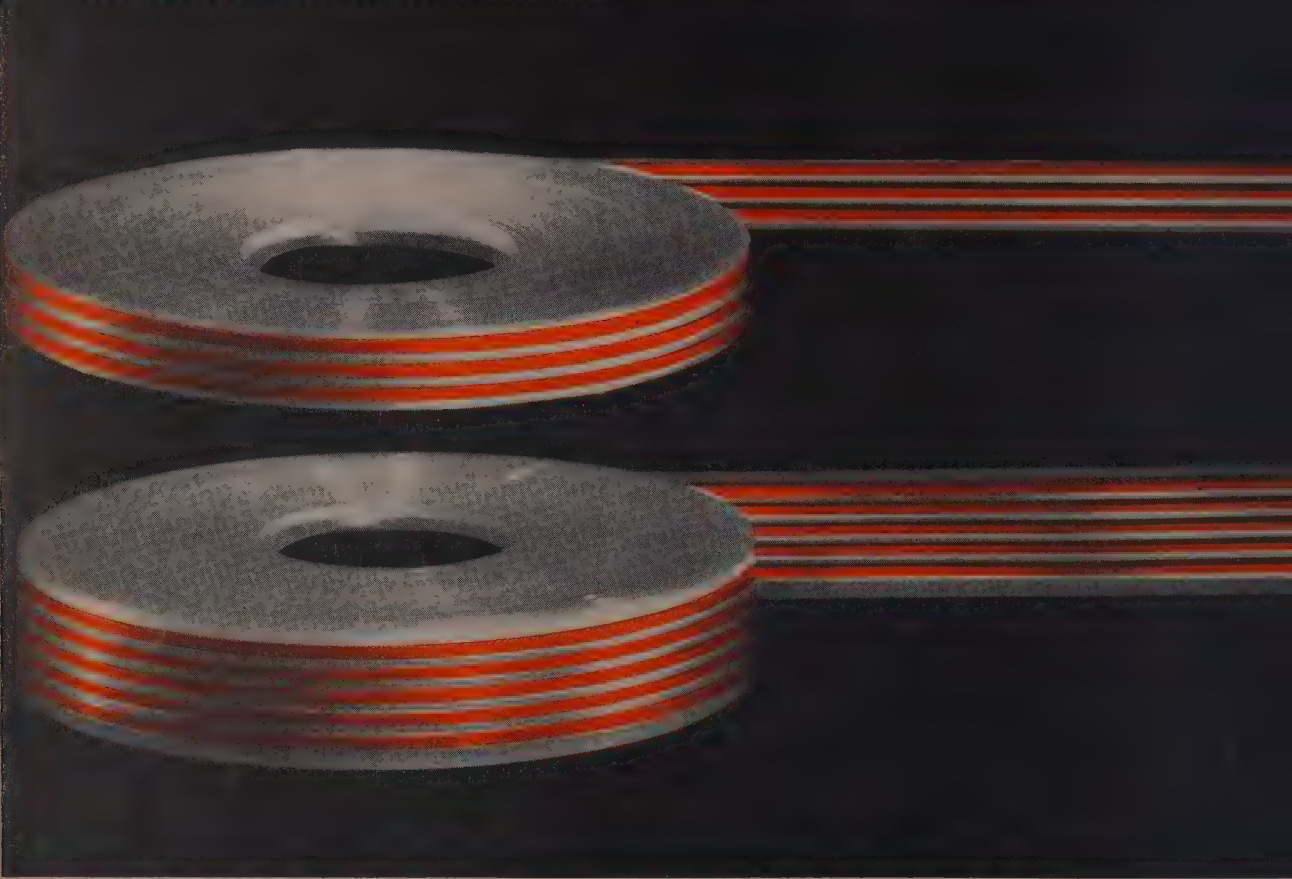
SUBMERGED-ARC WELDING on tank seams, bracing, and flanges provides more uniform welds.

NEW FORMED BASE permits rolling, skidding transformer for installation ease.

Progress Is Our Most Important Product

GENERAL ELECTRIC

In ELECTRONIC COMPONENTS if it's news, expect it first from IRC



POLYSTRIP...the new easier w

FLAT, FLEXIBLE 3- and 5-CONDUCTOR CABLE SAVES INSTALLATION TIME AND MONEY

POLYSTRIP is a new concept in cabling, developed by IRC. Where time is money, the speed of installing POLYSTRIP results in big savings over older wiring methods. For instance, POLYSTRIP slips between wallboard seams, behind moldings, and through many openings, thus eliminating drilling and cutting of walls and woodwork. Ultra thin POLYSTRIP lies under floor coverings without causing bulges. It can be fastened to finished
walls, ceilings and baseboards with double-backed
doing away with need for conduit or plaster-crac
hardware. The many features of this new product
POLYSTRIP equally valuable for new construction
modernization of existing buildings.

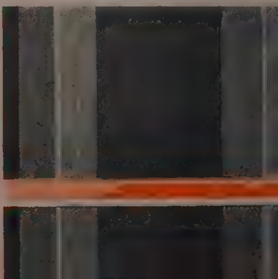
POLYSTRIP consists of uniformly spaced flat co
conductors laminated with transparent plastics in
very thin, flexible, flat cable. Already proved in indus
electronic equipment, it is now applicable for hi-fi, pa
signalling and alarm systems, programming, wired re

Installs behind surbases

Lies under floor coverings

Conceals easily behind wallpaper

Saves drilling through walls and



make low-voltage interconnections

ision control and many other installations. STRIP Installer's Kit . . . Available now at rical distributors.

RNATIONAL RESISTANCE COMPANY
Jorth 13th Street, Philadelphia 8, Pennsylvania

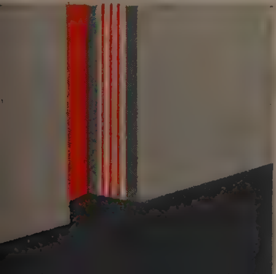
POLYSTRIP INSTALLER'S KIT SAVES 47% OVER SEPARATE PRICES OF ITEMS. IT INCLUDES EVERYTHING THAT'S NEEDED FOR ONE OR MORE INSTALLATIONS.

1—75-foot roll of 5-conductor POLYSTRIP cable
1—75-foot roll of 3-conductor POLYSTRIP cable
6—#5PWR (splicing type) connectors* for 5-conductor cable
2—#5PWA (wire lead type) connectors* for 5-conductor cable
6—#3PWR (splicing type) connectors* for 3-conductor cable
2—#3PWA (wire lead type) connectors* for 3-conductor cable
1—50-foot roll of double-backed pressure tape
1—Stripping tool
1—Data/instruction booklet

*T & B POS-E-FLEX connectors

SPECIAL INTRODUCTORY PRICE $27.72

etween wallboard seams



Folds flat for workmanlike angles

Attaches quickly with pressure tape

50 to 100% greater current capacit

ONCE AGAIN...

Thank You Gentlemen

We are proud that Ideal Wing-Nut connectors have been selected for making branch circuit and fixture wire connectors on your projects.

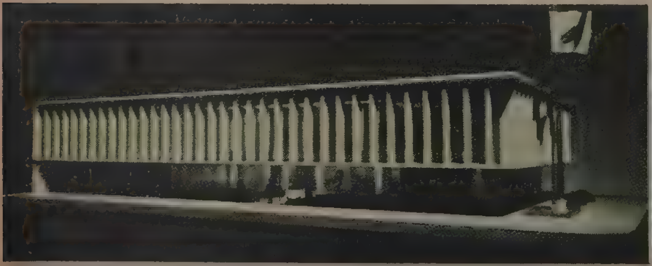
City-County Building
Indianapolis, Indiana

Architect:
Allied Architects & Engineers
of Indianapolis, Inc.

Consulting Mechanical and
Electrical Engineers:
J. M. Rotz Engineering Co., Inc.

General Contractor:
Huber Hunt & Nichols, Inc.

Electrical Contractor:
Joint venture of
The Sanborn Electric Co. and
Watson Flagg Electric Co., Inc.



Society for Savings Bank
Springfield, Ohio

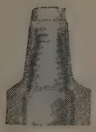
Architect:
Shaw, Metz & Associates
Chicago, Illinois

Electrical Engineer:
John Dolio & Associates
Chicago, Illinois

Contractor:
George C. Turner
Electrical Contractor, Inc.
Dayton, Ohio

Wing-Nut

IDEAL



Leading architects and contractors everywhere are using the Wing-Nut connector for several important reasons:

More U.L. approved combinations than any other screw-on connector: 474 solid and/or stranded copper wire joints, and every common aluminum-to-aluminum combination.

Surpass rigid U.L. and C.S.A. tests . . . for holding power, pull-out and high dielectric strength. They are built to withstand even more severe conductivity and vibration tests than required by U.L.

Unique wings provide a natural, powerful grip. This built-in wrench design makes Wing-Nut twice as easy to screw on as any other connector.

Nylon shell has deep, wide skirt to easily handle even thick type RHW insulated wires. You can actually see your splice is tight through the semi-transparent shell.

Wing-Nut makes the safest, strongest, tighest, fastest, most shake-proof screw-on wire connection possible.

This is why more and more prestige buildings have *all* electrical splices made with Wing-Nut. See for yourself. Write for free samples of both sizes and technical literature.

Capehart Housing Project
McCoy Air Force Base
Orlando, Florida

Architect:
Joseph H. Bryson, A.I.A.

Electrical Engineer:
Lee Stuhl
Orlando, Florida

Contractor:
United Electric Company
Jacksonville, Florida

Empire House, New York, N. Y.

Architect:
Schuman & Lichtenstein
New York

Electrical Contractor:
Zwicker Electric Company
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IDEAL INDUSTRIES, INC. 1041-F Park Avenue, Sycamore, Illinois

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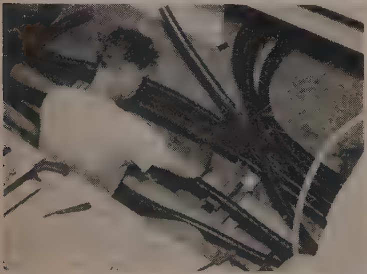
NAME YOUR CABLE PROBLEM—THERE'S A GOOD CHANCE DURASHEATH CAN SOLVE IT.

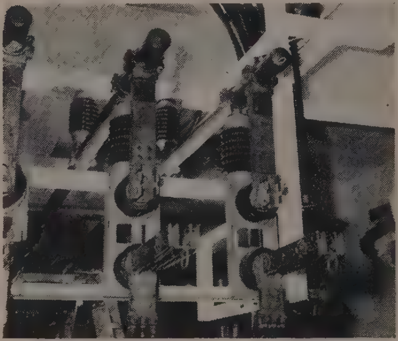
Durasheath is versatile, easy to install—indoors, outdoors, above ground or below. Here are 5 examples.

Riser Cable. In this installation, Durasheath not only serves as an aerial cable, but also as a riser cable running down the side of the building. Without additional terminations, it then drops down-inside to the plants' power-control center. It's another example of the way versatile Anaconda Durasheath adapts itself to your power cable needs.



Installed in ducts. Durasheath's flexibility meant quick and easy installation here. And once installed, its tough neoprene jacket assures long, trouble-free life. Because Durasheath adapts itself to so many uses, your inventory problems are lessened—fewer cables need be carried in stock.

Field or factory-assembled aerial cable. Durasheath may be factory pre-assembled with standard or reverse lay. Or it can be quickly field assembled with the simple spinning operation shown here. Either way, easy splicing, tapping, and terminating result in simplified installation. No cross arms or insulators are needed.



Inside installation. Here's an application where Durasheath was quickly installed and easily terminated. Durasheath's Neoprene jacket resists abrasion, heat and fumes. *Assures dependable performance and long-range economy.*

ANACONDA DURASHEATH ALL-PURPOSE POWER CABLE is available in all sizes, single and multiple conductor, copper or aluminum, 600 to 35,000 volts. *Insulations:* Type RHW, Anaconda ANW, AHW, or AB butyl rubber compounds; each designed for specific purposes. *Jacket:* specially compounded neoprene with high resistance to flame, oil, acids, alkalies, sunlight, and ozone. Has high tensile strength and is flexible over a wide range of temperatures.

Direct-burial cable. The moisture-, oil-, and acid-resistance of Durasheath's jacket makes it the ideal cable for direct-in-the-ground applications like the one shown above. Its flexibility cuts installation time and cost because Durasheath is easy to handle. Its durability cuts maintenance costs.

For complete information about Anaconda Durasheath contact Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York, Department EFL-1-EC & M.

61266-C

ASK THE MAN FROM

ANACONDA®

FOR DURASHEATH ALL-PURPOSE
POWER CABLE

Only BURNDY offers all three!

THERMOWELD®—COMPRESSION—BOLTED

thermOweld

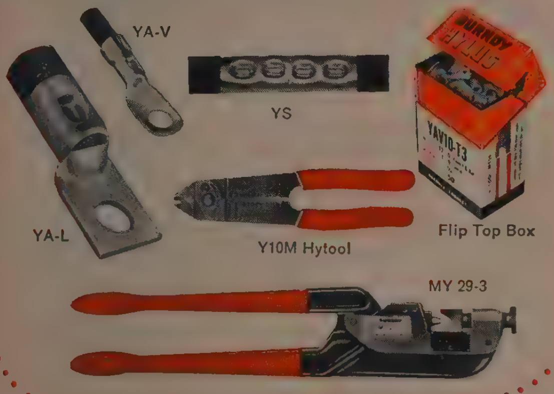
Weld anywhere with lightweight THERMOWELD. Self-contained, needs no external source of power.

Pour powder into mold, tap. Starting powder won't mix with welding powder, assures positive firing.

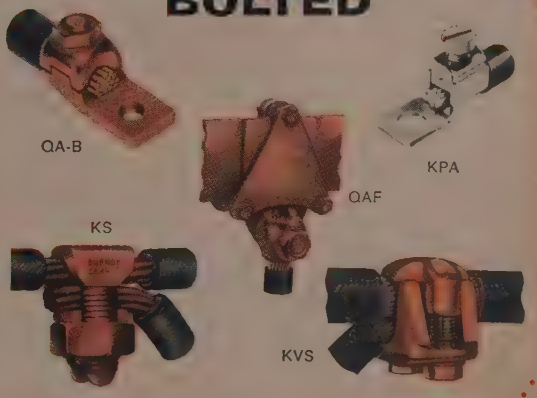
Close cover, ignite with flint gun. THERMOWELD forms liquid copper which fuses conductors into solid mass.

Welds a permanent electrical connection easily and economically to any copper conductor or steel structure.

COMPRESSION



BOLTED



AVAILABLE AT YOUR BURNDY DISTRIBUTOR

BURNDY

61-13

NORWALK, CONNECT. BICC-BURNDY Ltd. Prescot, Lancs., England In Europe: Malines, Belgium TORONTO, CANADA

"A Heated Discussion"

A short play on words and conduit

White hat: Whoo, boy, this is a real scorcher! Hardly breathe near this blast furnace. Show me those steel raceways.

Dark hat: Here they are. Been up there for years in all this heat. Hasn't fazed them a bit.

White hat: That'll look great in my report. Don't you think we're a little close to that hot stuff? I got this heavy wool suit on and . . .

Dark hat: You don't have to baby steel conduit, nossir. It's got the strength to take all the manhandling you can give it—and you can bend it without worrying about flattening or wrinkling.

White hat: Look at that hot stuff slosh around in there!

Dark hat: And you don't have to protect steel raceways with any organic covering when you run them through or along concrete. Saves a lot of time when you're putting in two, three miles of raceways.

White hat: Yeah. Well, that about wraps it up. Let's go!

Dark hat: You can thread steel conduit with regular dies and you don't need special lubricants to do it. Makes them easy to install and saves plenty of time and money.

White hat: You bet. Let's get out of here!

Dark hat: Steel conduit gives you a grounded metallic system, too; induced currents are drained off without danger.

White hat: Let's go!

Dark hat: Steel conduit's got a smooth interior; makes it easy to pull wires and cable and saves you a lot of time and money if you ever have to rewire. Let's go, OK?

White hat: Say, notice an odd smell . . . like wool burning?

USS
TRADEMARK

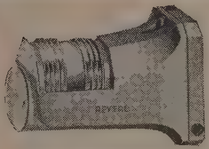
National Tube
Division of
United States Steel

Columbia-Geneva Steel Division, San Francisco,
Pacific Coast Distributors

United States Steel Export Company, New York

America's leading steel pipe manufacturer supplying America's foremost conduit manufacturers

Steel This mark tells you a product is made of modern, dependable Steel.


No. 3151-A Floodlight

Widest line of fixtures lets you achieve decorative lighting effects the one best way for each job

When you plan an outdoor application for dramatic architectural lighting, plan it the way you know is best for the job, then see your Revere wholesaler for the lighting equipment required. From Revere's complete line, you can select exactly the right fixtures to give the decorative lighting effect you want.

Revere offers the industry's widest line of matched outdoor lighting equipment. For decorative lighting, or parking lots, or sports areas, or airports—or for virtually any outdoor application — Revere equipment lets you solve the problem the one *best* way. Whatever you need — hinged or rigid poles . . . mercury, incandescent or fluorescent luminaires . . . floodlights, fixtures, fittings — can be supplied by Revere in the size and types specified in your plans.

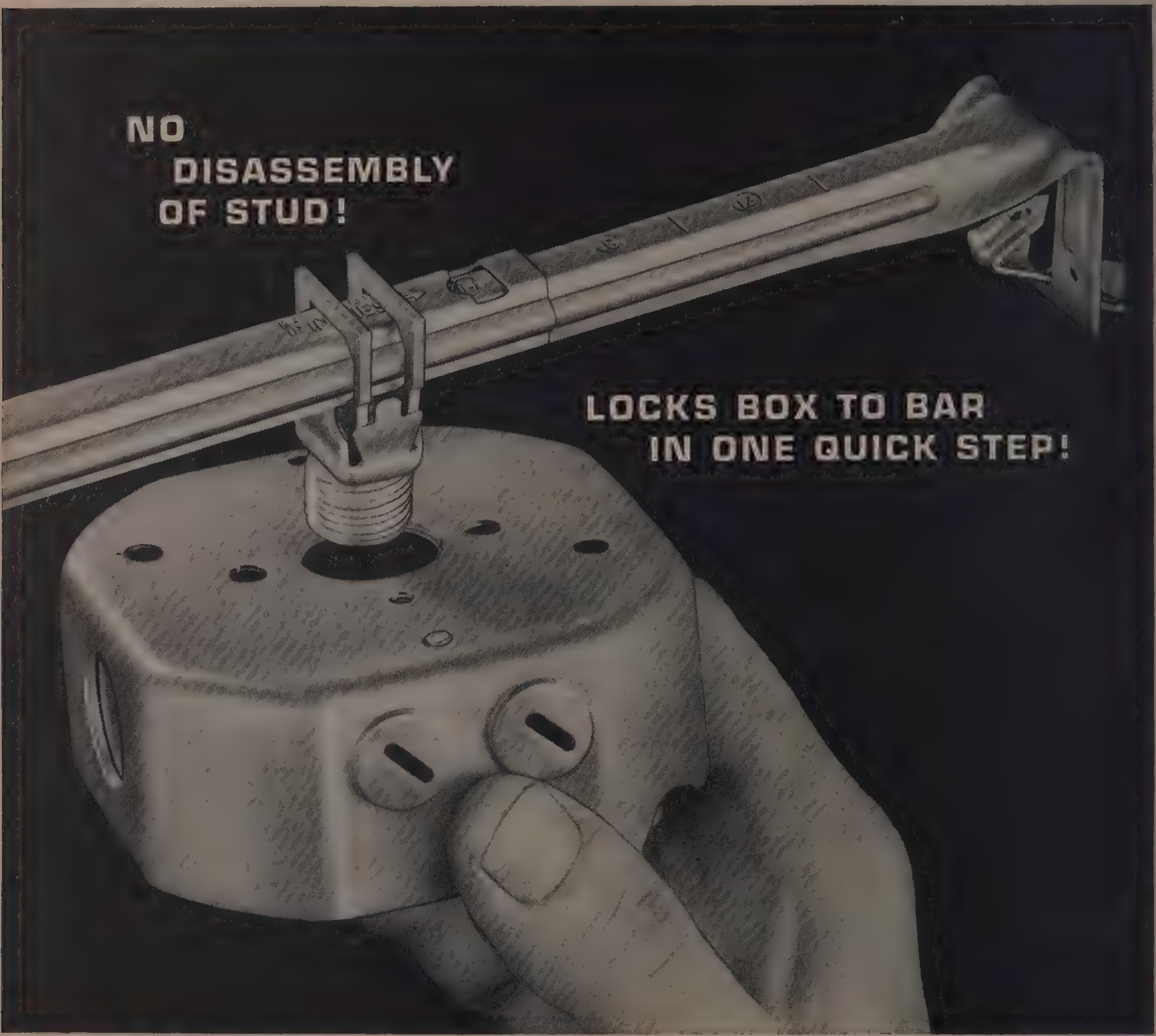
Ask your wholesaler about Revere outdoor lighting equipment for your next job. For a copy of Revere's catalog, write to us.

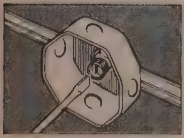
Revere
ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200 • Telegrams: WUX Niles

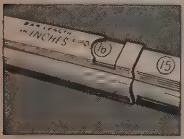
NEW EFCOR BAR HANGERS





CUTS ASSEMBLY TIME —— Just remove the outlet box knockout, slip box over bar hanger stud, tighten with screwdriver, and you're set! No parts to remove and replace.

Plus these added features for fast, dependable installation!

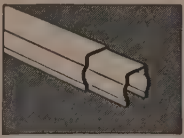


EXCLUSIVE LENGTH GAUGE
Lets you pre-set hanger bar length before installation.

EXCLUSIVE GRIPPER PRONGS*
Permanently locks prong into wood.

*Pat. Applied For

HEIGHT GAUGE
Accommodates most common settings—easily snapped off for other applications.



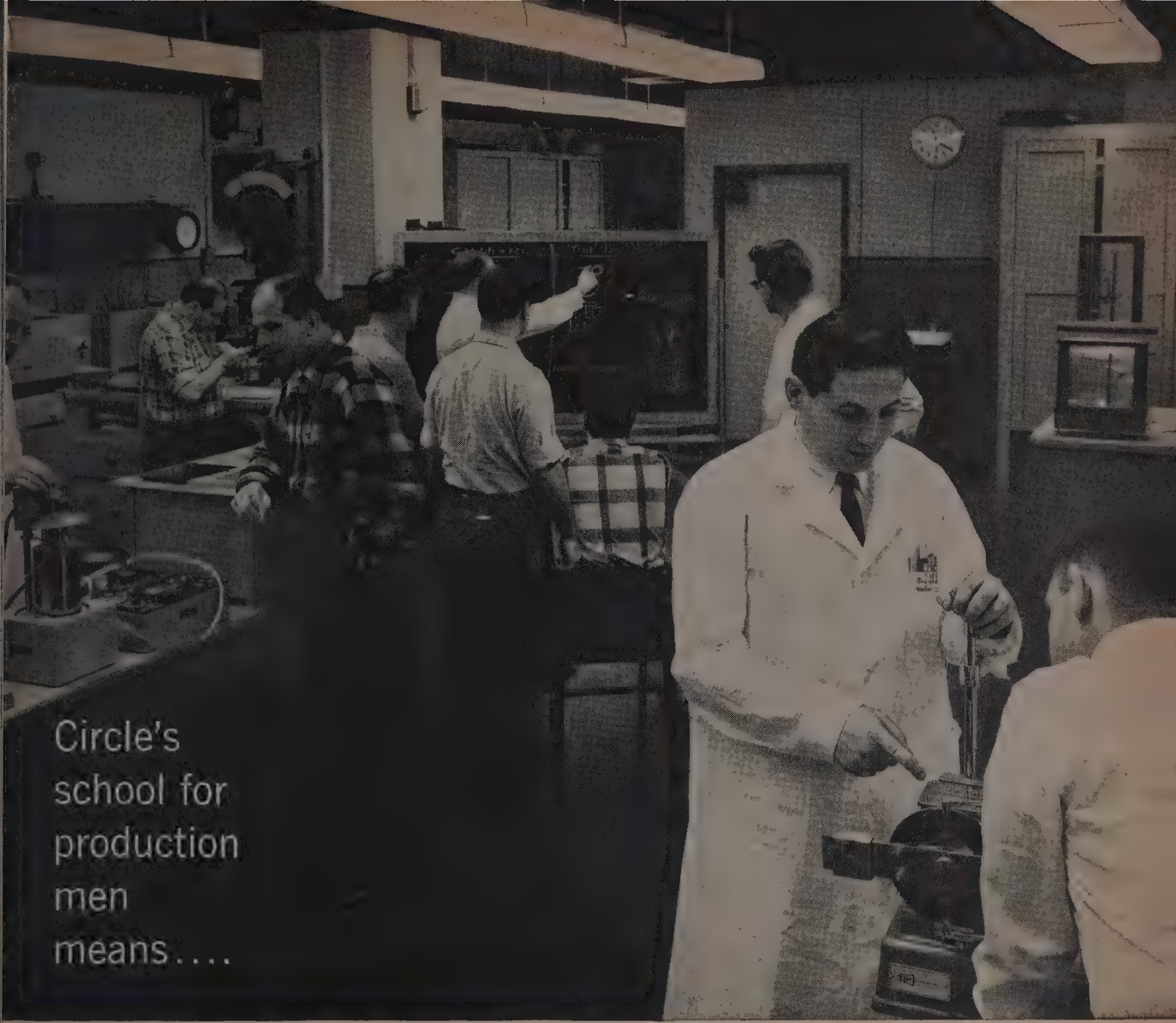
EXCLUSIVE NON-SLIP BAR SECTIONS
Slide easily for proper length setting but will not fall apart.

HEAVY-DUTY CHANNEL DESIGN
Special rib-reinforced bar cross-section resists bending, twisting—takes 20% greater loads.

Available in both stud and no-stud assemblies. Can be reversed for additional installations. Just two bar sizes cover any length from 11½" to 26½". Also available in preassembled box and bar units. SEND FOR FREE SAMPLE.

Efcor

ELECTRICAL FITTINGS CORPORATION • 37-50 57th St. • Woodside 77, N. Y.



BETTER WIRE AND CABLE FOR YOU

It isn't enough to build cable quality in the laboratory. There has to be follow-through in production.

And that calls for production men who not only care enough but *know enough* to consistently turn out top quality products.

That's why Circle production men "go to school." Periodically they attend lectures given by skilled laboratory technicians. They review such subjects as extrusion techniques, proper operating speeds, production line testing procedures, etc.

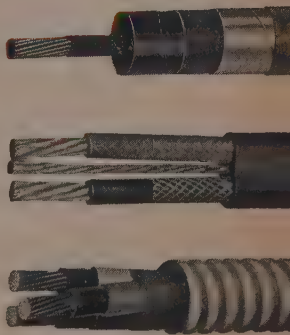
In-plant training such as this is unusual for wire and cable men. It is one of many reasons, however, why Circle products have achieved a reputation for high quality.

Next time you buy or specify cable, ask for Circle . . . there's no finer cable made.

**Trade Mark*

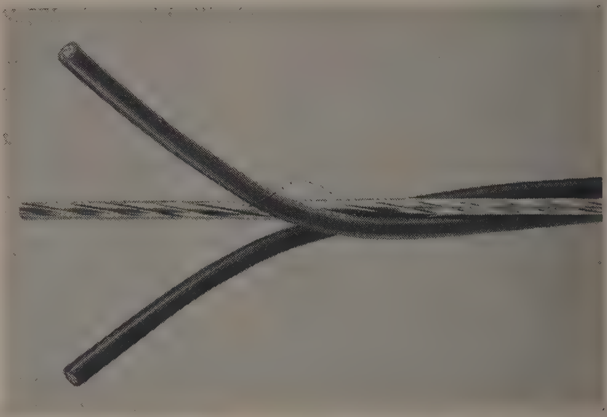
CWC **CIRCLE** WIRE & CABLE
a subsidiary of
CERRO CORPORATION

RUBBER COVERED WIRE & CABLE • VARNISHED CAMBRIC CABLE • PLASTIC INSULATED CABLE • NEOPRENE SHEATHED CABLE • CIRTUBE* EMT

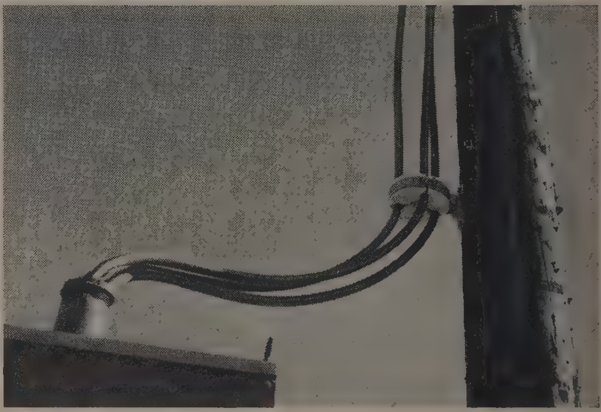


Three new electrical applications use HYPALON® for color coding, resistance to weather, ozone, corona

High-Performance Du Pont Synthetic Rubber Proves Its Versatility as Jacketing and Insulation for Wire and Cable.



Color-coded triplex with HYPALON jacket *and* insulation permits accurate phase identification. HYPALON jacket will not discolor . . . resists flame, weathering, abrasion, hot and cold flow.



Aerial cable for industrial locations is covered with HYPALON for resistance to corrosive fumes, air-borne chemicals, ozone and corona discharge. HYPALON jacketing is *practically immune* to ozone, will not support combustion, resists exposure to oil and grease.

Corona-resistant connectors molded of HYPALON are rated at 7500 volts . . . permit the use of higher voltage portable machinery in plants and mines. HYPALON is virtually corona-*proof* compared to other elastomers . . . offers good resistance to abrasion, oxidizing chemicals.

These latest electrical applications for HYPALON synthetic rubber illustrate the versatility obtainable with this new wire and cable covering material. HYPALON'S outstanding resistance to weather, aging, ozone, corona, flame, abrasion, oil and chemicals (proven in 10 years of wide industrial use) means long life and economical performance to meet the most demanding service needs. That's why HYPALON is specified for high-performance automotive ignition wire . . . mine trailing cable . . . tree wire . . . service drop wire . . . submarine cable . . . building wire . . . to list just a few of its current applications. Learn more about Du Pont HYPALON and how it can improve performance of the cable and electrical accessories *you* use. For information, write E. I. du Pont de Nemours & Company (Inc.), Elastomer Chemicals Dept. ECM-6, Wilmington 98, Del.

DU PONT
REG. U. S. PAT. OFF.

HYPALON
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

WIREMOLD®
ELECTRIC IDEAS

PREPARED EACH MONTH FOR ELECTRICAL CONSTRUCTION AND MAINTENANCE TO BRING IDEAS, NEWS AND HELPFUL INFORMATION TO ELECTRICAL MEN

62nd YEAR

JUNE 1961

SURFACE SYSTEMS FOR INDUSTRY ... FIRST PAGE
CODE COMMENTS ... FIRST PAGE
EDITORIAL ... SECOND PAGE
PRODUCT OF THE MONTH ... SECOND PAGE
QUIZ CORNER ... SECOND PAGE
COUPON FOR FREE ITEMS ... SECOND PAGE
ENGINEERED SPECIALS ... FOURTH PAGE
USEFUL LITERATURE ... FOURTH PAGE
PRACTICAL TIPS ... FOURTH PAGE

Industrial Wiring Proves Surface Systems Versatile

Industry requires flexibility, convenience, and economy of surface systems for power, lighting, and communications

To American industry goes much credit for recognizing the value of surface systems for electrical wiring. Since the introduction of these surface raceways, industry has been one of their staunchest users.

The reason for this steadfastness is readily apparent. Although cost conscious, industry also recognizes that value and reliability are important considerations in plant planning. A factory that can't run,

continued on third page

MULTIPLICITY of outlets to handle diversified testing equipment was accomplished by use of four runs of 3000 raceway. Bottom two runs are 60-cycle; third run is 400-cycle. Fourth row is held in reserve for anticipated future requirements.

Code Comments

Raceway Mounting Clips

Q. *Do I have to use a mounting clip of some kind every five feet on your raceways? Can't I let the boxes hold it if I have a box every six or seven feet?*

A. Section 110-11, Article 110 of the Code states, "Electrical equipment shall be installed in a neat and workmanlike manner." Section 300-11, Article 300, states: "Raceways, cable assemblies, boxes, cabinets and fittings shall, unless otherwise provided, be securely fastened in place, unless otherwise provided for specific purposes elsewhere in this Code." And Section 352-2, Article 352, states: "Installations of surface metal raceways shall comply with the applicable provisions of Article 300."

Grounding Raceways

Q. *I have heard that when using Wiremold or Plugmold a separate,* extra *grounding wire must be run to ground the system. Is this true?*

A. The Code, in Section 300-10, Article 300, provides "Metal raceways, cable armor, and other metal enclosures for conductors, shall be metallically joined together into a continuous electrical conductor, and shall be so connected to all boxes, fittings and cabinets as to provide effective electrical continuity. Raceways and cable assemblies shall be mechanically secured to boxes, fittings, cabinets and other enclosures, except as provided for non-metallic boxes in Section 370-7."

WIREMOLD®

Advertisement

Editorial

No electrical do-it-yourself

We're not against *all* do-it-yourself projects, just those that could prove dangerous in the hands of the technically uninformed.

Leading the list of projects we're opposed to is do-it-yourself electrical wiring in any form.

Our views on this subject are no secret; we've taken a public stand on this matter on several occasions. We sincerely believe there is an inherent danger in slipshod, make-do wiring.

To carry this thought to the public, we have created advertising mats to enable you to carry this message to *your* customers. We'd welcome your assistance in this program.

Check the coupon below for your free mats.

Product of the Month

Wiremold tools simplify snaking wires through 500 and 700 raceway

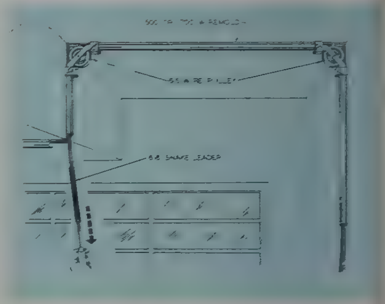
Two Wiremold tools developed to simplify snaking conductors through Wiremold 500 or 700 are the 615 Wire Pulley and the 616 Snake Leader. These may be used in combination or individually.

The wire pulley is designed for guiding wires at inside corners. It is often helpful to use two or three pulleys on a single pull (see illustration).

The pulley is attached to the raceway quickly and easily by means of thumbscrews on each clamp. The wires are snaked through the raceway with the pulley guiding them around the corner.

The 616 Snake Leader is intended for use in snaking conductors through Wiremold 500, 700 and 1000. It offers a minimum amount of bulk; the conductors lie parallel to each other, permitting smooth and easy snaking and preventing cross-overs and kinks.

To use the leader, hook stagger-stripped ends of wires through holes in the leader; next, fasten leader to snake; pull snake, leader and wires through raceway.



Quiz Corner

Q. *Do you have a 3-wire, single-circuit multi-outlet system with the third conductor bare copper ground?*

A. Yes, the 20GB and 22GB series. See Wiring Guide 22.

Q. *Can the 20GB and 22GB series be furnished with the receptacles wired alternately?*

A. Yes, on special order, but minimum outlet spacing is 12 in.

Q. *Are Wiremold products union made?*

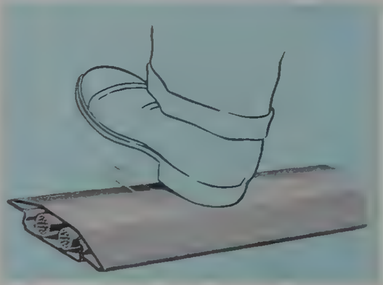
A. Yes, by members of Local BA-1040, IBEW.

Q. *Is the 57200 series available as boxes without devices?*

A. Yes, on special order.

Q. *How do I install Pancake 1500 and 2600 cover?*

A. Hook one side under the bead of base and apply pressure by stepping on cover with a glancing blow until it snaps in place. Cover should overlap where two lengths of base meet.



Q. *What fittings are available for use with 2600 Pancake when it is used as a power system?*

A. The following fittings in the 1500 Pancake series are equipped with double twistouts, one for 1500 and one for 2600: 1543L Duplex Receptacle; 1543AL Polarized Duplex Receptacle; 1543GL Grounding Duplex Receptacle; 1546A Single Receptacle Box; 1546B Duplex Receptacle Box.

Q. *Is a combination connector available for use with 200 Wiremold?*

A. Use 5785 with 289 Reducing Connector.

WIREMOLD®

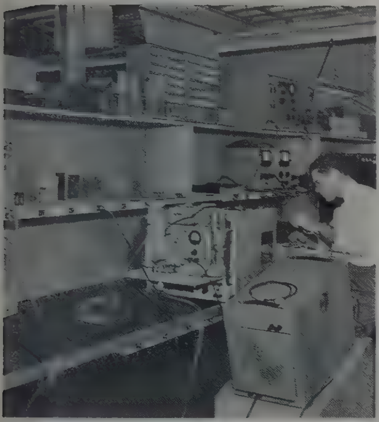
WIREMOLD ■ HARTFORD 10, CONN.
Gentlemen: Please send me checked items

NAME ____________________
COMPANY ____________________
ADDRESS ____________________
____

- ☐ Category Sell-Up Set
- ☐ Don't Do-It-Yourself Mats
- ☐ Electric Ideas, May 1961
- ☐ Electric Ideas, April 1961
- ☐ Wiring Guide (Catalog 22)

E1-6

Industrial Wiring Proves continued from first page



THE NEED for convenience, safety makes Plugmold ideal for electronic benches.

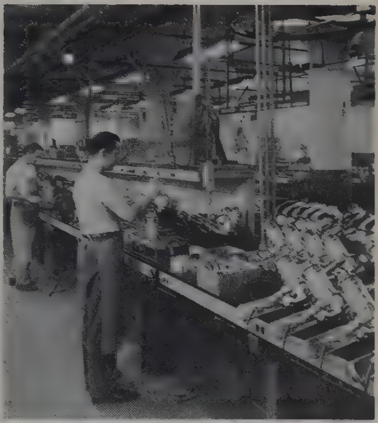
PLUGMOLD 2000 makes each bench a convenient workshop of its own.

or an office that is unable to function, represents a total loss.

The many uses to which industry puts surface systems are as varied as industry itself. Test and assembly benches, laboratory tables, power for machinery, power for lighting, communications wiring, and as a power source on original equipment (see "Engineered Specials," fourth page) are among the more common uses.

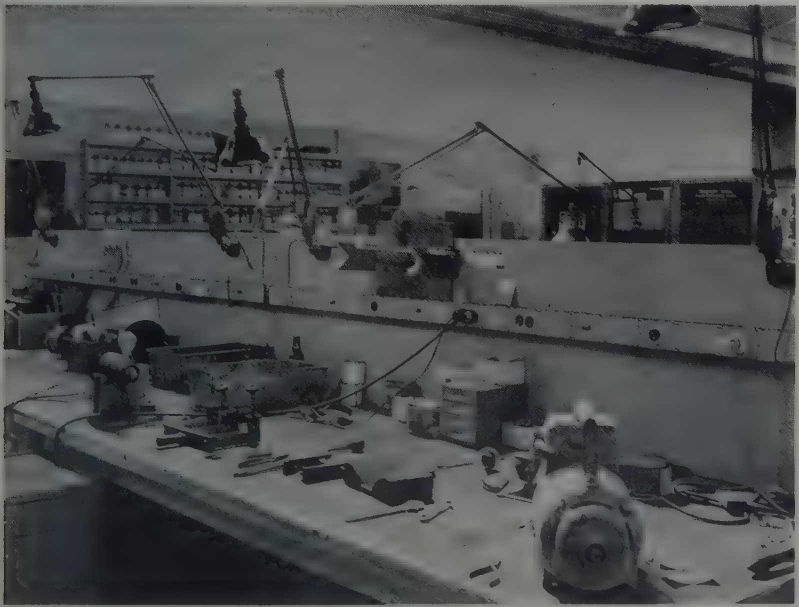
One of the more popular modern approaches being specified by plant planners is the Tele-Power system. This consists of two parallel runs of Plugmold, one for power and the other for communications wiring. This technique not only meets the requirements of separating high and low voltage wiring, but provides a neat, inconspicuous installation with plenty of conveniently located outlets.

The completeness of the Wiremold line of fittings and devices also makes installation rapid and simple, avoiding the need for complex, in-field improvisation. Again, the varying capacities of the different raceway series permit the carrying of a maximum number of conductors and circuits within a single raceway. And the ease with which it is possible to get at the wiring, assures simplicity of maintenance and re-circuiting.

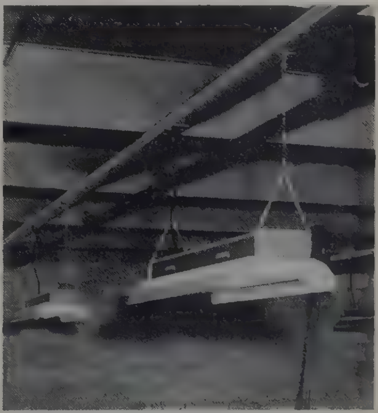


FINAL ASSEMBLY and inspection are faster when electric power is readily at hand.

PERIMETER WIRING with Plugmold 3000 provides electrical facilities for small shop.



VERSATILITY of surface systems is demonstrated by this Plugmold 3000 run. The multi-circuit set-up powers a variety of receptacles, indicator lights and switches.



PLUGMOLD 3000 houses the conductors for the lighting circuits and provides the means for suspending these industrial fluorescent units.

WIREMOLD®

Engineered Specials

Molding press uses Plugmold for electric power and as pneumatic lines housing

PROBLEM:

To provide a molding press with a built-in system for switching, light, heating coils and indicators. A similar set-up was required to house three pneumatic pipe lines.

SOLUTION:

Two runs of Plugmold 3000 were built into the press by the manufacturer. Mounted on the frame, one run houses the electric conductors; the other the pneumatic lines. Both runs were painted to blend with the press.

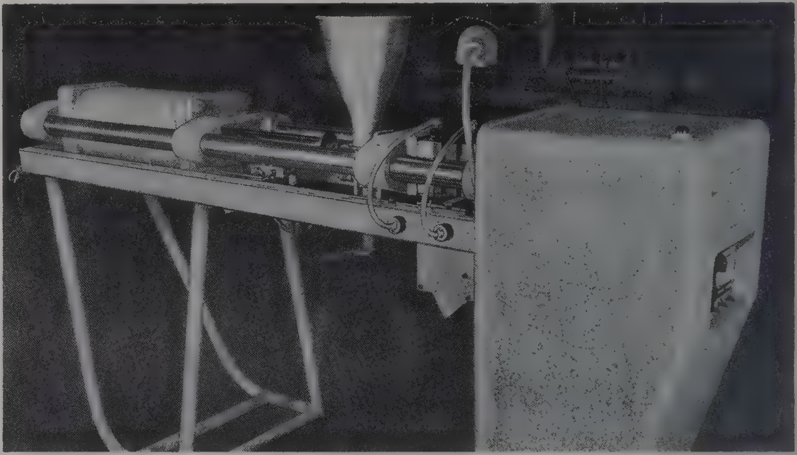
DISCUSSION:

In cooperation with the machine manufacturer, Wiremold engineers chose Plugmold 3000 as being most easily adapted for both requirements.

Piercings were made in the side of the raceway for three switches and two indicators. Disconnect means is provided for the heating coils; a work light also is included. Wiring is easy to get at, simply by removing the raceway cover.

In the same position on the opposite side of the press, the 3000 raceway makes a neat, unobtrusive housing for the three pneumatic pipe lines from the compressor.

More and more frequently, standard units and adaptations of Wiremold systems are specified for original equipment. Wiremold engineers are pleased to assist in modifying Wiremold systems to meet special requirements.



USEFUL LITERATURE

Check coupon on second page for copies of listed item.

Category Sell-Up Sheets

Designed to assist the contractor in selling-up, this set of ten illustrated sheets shows how Plugmold gives more outlets for less money. Categories covered include laboratories, industrial, electronics, kitchens, family rooms and workshops, dining rooms, bedrooms, living rooms, offices, and stores. The set is contained in its own packet for easy, convenient display to potential customers. Sheets are color-coded for rapid selection of proper category. Photographs of actual, identified installations provide forceful, authentic background to your selling activity.

Practical Tips

Supporting clips preferable for Wiremold installation

Use of supporting clips in place of straps when installing one-piece Wiremold results in a faster, neater installation.

One reason for this is that the fastenings can be installed before the raceway is in place. The Wiremold run is then simply pressed into the clip with hand pressure and the run is securely mounted. Once the raceway is in place, the clip is hidden.

Clips are available for all the one-piece series and are identified by the last two numbers "03". Thus, for Wiremold 200, use 203; for 500 and 700, 5703; and for 1000, 1003.

For those applications where the surface is uneven, it may be necessary to use a supporting strap. Although simple to use, and available for all one-piece raceways, it is slightly more time consuming and is not concealed after the installation is complete.

The Wiremold Wiring Guide contains many time-saving tips which lead to a neater job. Check coupon on second page for a copy.

WIREMOLD®
HARTFORD 10, CONNECTICUT

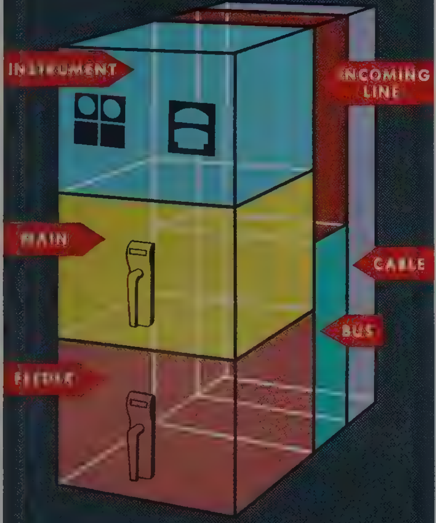
All WIREMOLD products are sold through electrical distributors — your best source for all electrical products.

Advertisement

SWITCHGEAR
AS NEW INSIDE
AS IT IS OUT

INTRODUCING . . .

New Powermaster Type AKD-5 Low Voltage Switchgear



Phantom view illustrates significant advances in compartmentation achieved in Powermaster Switchgear.

Highlighted by a new concept in appearance design, General Electric's new Powermaster Type AKD-5 Switchgear reflects the needs of today's modern power systems for increased safety, added convenience and . . .

GREATER RELIABILITY

For the highest degree of service continuity, compartmentation and isolation of the key functional components in the equipment:

Minimize fault hazard—separate bus compartment prevents the entry of foreign objects such as tools, rodents, fish tapes, etc.—the major cause of bus faults.

Minimize fault communication—isolated incoming line compartment reduces hazard of fault transfer from the main bus to incoming line—thus permitting more effective operation of the main breaker on any possible bus fault.

Reduce maintenance requirements—Welded bus provides positive joints with a high degree of electrical conductivity—minimizes periodic tightening of bus bolts. New bus configuration and enclosure reduces dust contamination—minimizes cleaning requirements.

Call your General Electric sales engineer or send for publication GED-4269. *General Electric Co., Schenectady, N. Y.*

531-04

1000 KVA Load Center Unit Substation with Powermaster Type AKD-5 Switchgear. Colorful blue panels accent over-all appearance design.

GENERAL ELECTRIC

First from General Electric (1959)... another bright idea that became a better lamp for you...Quartzline lamp

packs more light in less space than any other filament lamp

Listen to the nearsighted Mister Magoo . . . "1959? Seems like last week! I volunteered but the authorities picked seven other Astronauts—and General Electric invented the Quartzline lamp. Happy birthday, Quartzline. Tarnation! This confounded pen won't write!"

Understandable mistake, Mister Magoo. The 5-inch, 500-watt Quartzline *is* no bigger than a pen. But it's 19% more efficient than a regular lamp, never grows dim, and provides better light control than any earlier lamp.

Every Quartzline lamp stays almost 100% bright throughout its life—because General Electric engineering leadership found a way to keep tungsten vapor from blackening the glass. G.E. puts iodine gas in the lamp to catch the particles evaporating from the tungsten filament. Miraculously, the iodine re-deposits them, over and over again, on the steadily-bright filament. This process makes the 5-inch Quartzline last 2000 hours, twice as long as a regular bulb-shaped lamp.

Use Quartzline with the right reflector, and it'll give a precise, powerful, rectangular beam of light in one direction—as narrow as 6° or as wide as 100°. No elaborate lens system is needed.

Or take the big-brother model, the 10-inch, 1500-watt Quartzline. It's *50% more efficient* throughout its life than a standard 1500-watter of comparable voltage.

Applications? Stadiums. Airport runways. Building facades. Show windows. Inspection or outdoor work areas. Don't worry about rain and snow. Quartzline resists thermal shock.

Ask your G-E distributor for more information on Quartzline lamps—small proof of General Electric lighting leadership! General Electric Co., Large Lamp Dept. C-110, Nela Park, Cleveland 12, Ohio.

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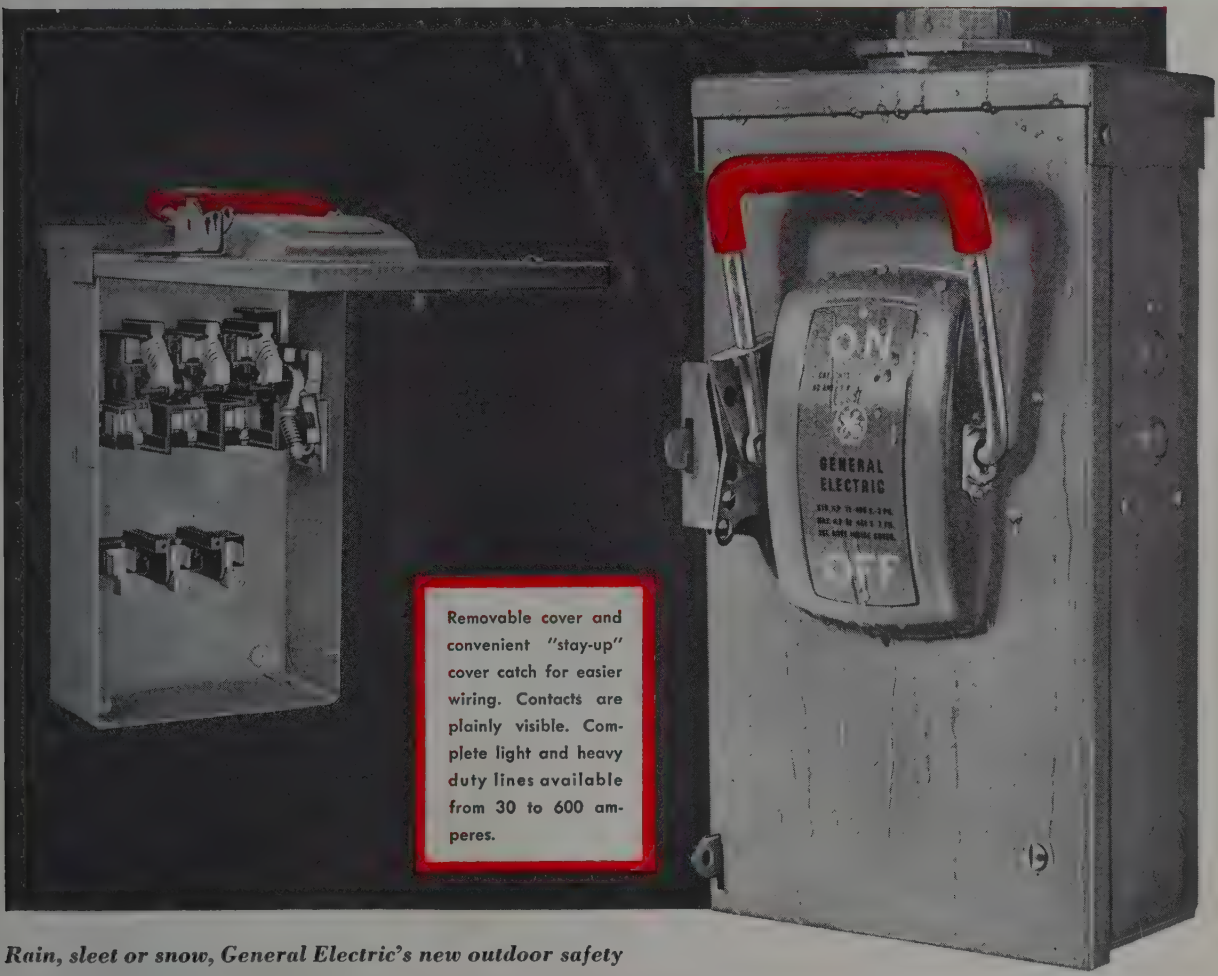
Progress Is Our Most Important Product

GENERAL ELECTRIC

THE RED HANDLE SAFETY SWITCH GOES RAINTIGHT



Removable cover and convenient "stay-up" cover catch for easier wiring. Contacts are plainly visible. Complete light and heavy duty lines available from 30 to 600 amperes.

Rain, sleet or snow, General Electric's new outdoor safety switches give the same reliable performance as the indoor models.

They're extra safe. The gasketed handle protects the operating mechanism for the life of the switch. The safety phase barrier protects against accidental contact. There are no fiber linkages in the mechanism to deteriorate with age, moisture or heat.

They're easy to install. Cover can be removed with only two screws. Convenient cover catch flips up at finger touch, stays up when two hands are needed for wiring. Mounting holes are raised for easy installation on uneven surfaces. Available in ratings from 30 to 600 amps, 240 and 600 volts, A-C. Write for bulletin GEA 6756 or see your G-E Distributor. Circuit Protective Devices Dept., Plainville, Conn.

GENERAL ELECTRIC

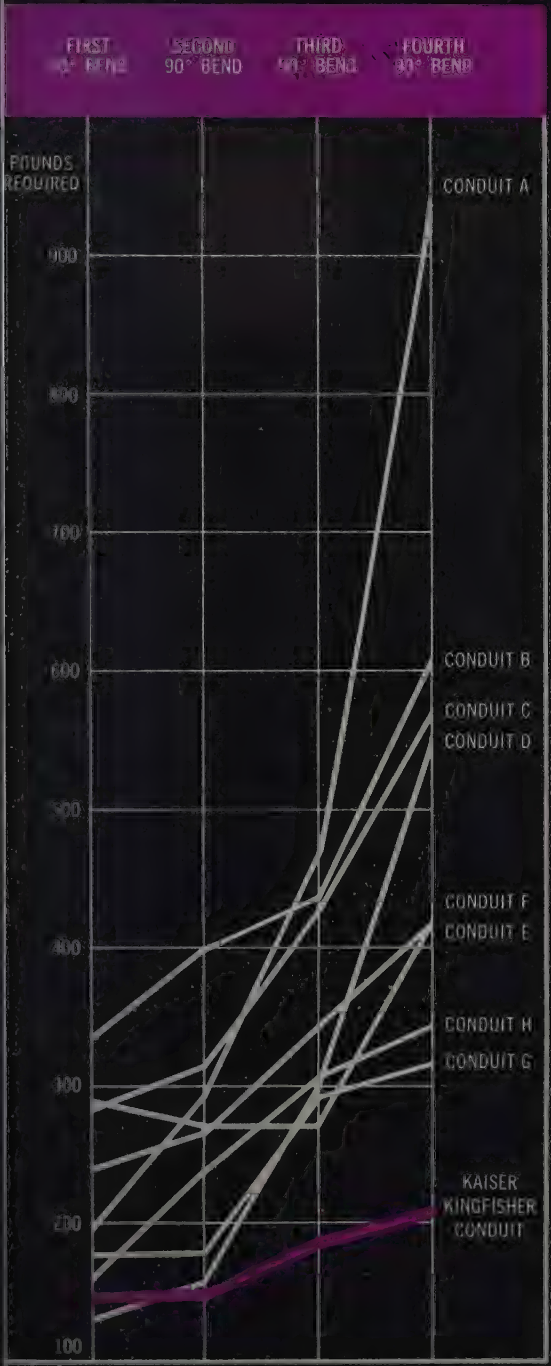
NEW!
KAISER ALUMINUM
KINGFISHER
ALUMINUM CONDUIT WITH K-40 SILICONE LINING

CUTS FISHING WORK IN HALF!

ERE'S PROOF. This chart compares manpower equired to pull cable through conduit. New Kaiser ingfisher—with exclusive K-40 Silicone lining—ulled 2.5% easier than galvanized steel conduit at he second 90° bend in tests . . . 36% easier than teel at the third bend . . . an amazing 61% easier han steel at the fourth bend!

UNDS OF PULL REQUIRED—ALUMINUM AND GALVANIZED STEEL CONDUIT

est pulls** of three fresh #2 RHW through 1¼-inch conduit with arious lining materials.



*In nine galvanized steel tests, four resulted in cable breakage at the fourth bend.

*Details upon request.

NOW AVAILABLE
COMPETITIVELY PRICED

Your Kaiser Aluminum Electrical Distributor now offers immediate delivery of competitively priced Kaiser Kingfisher Conduit.

Only Kaiser Kingfisher combines advantages of aluminum and K-40 Silicone lining. Saves up to one-third the man-hours by lightweight handling and installation of aluminum . . . eliminates cable breakage . . . resists corrosion . . . cuts fishing work in half! Ask for Kaiser Kingfisher by name.

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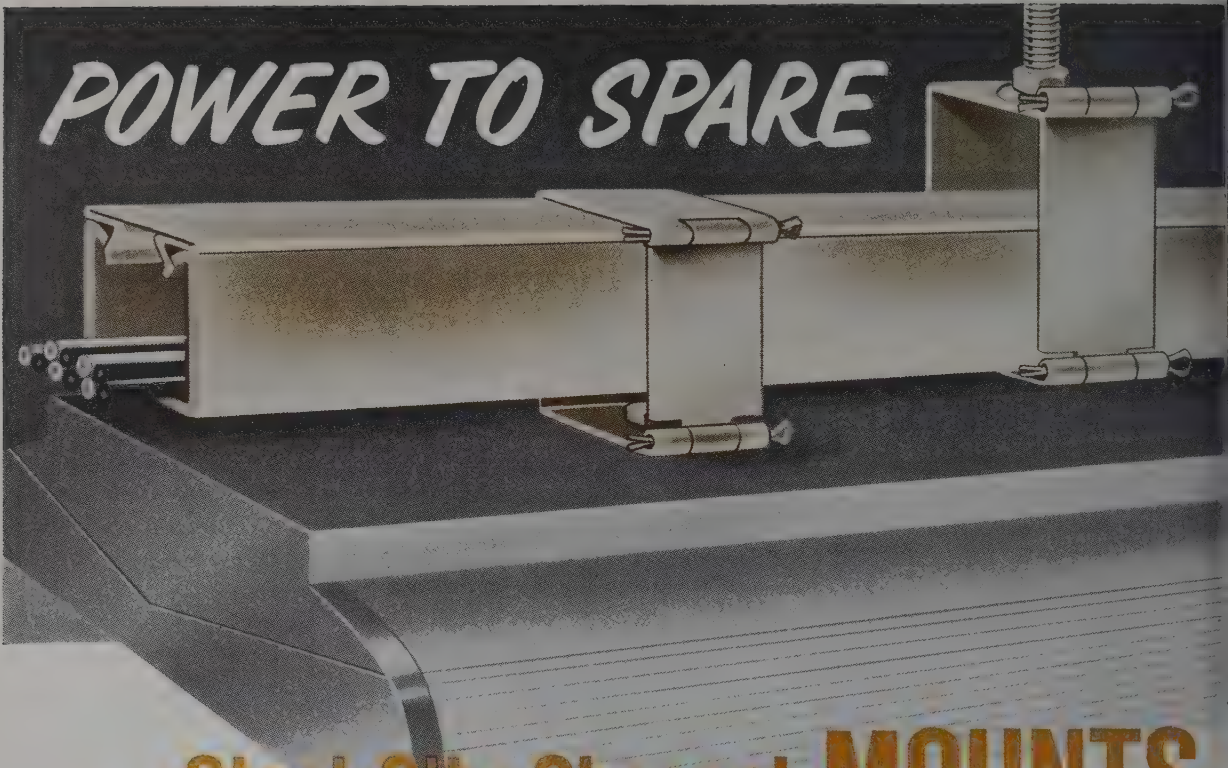


Steel City Channel MOUNTS-

FOR SURFACE

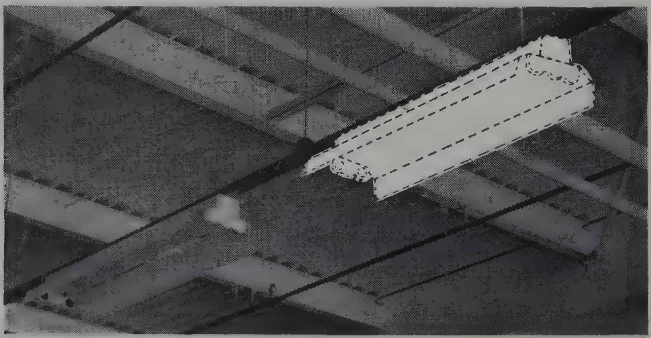
POWER TO SPARE—

A central wiring distribution channel with conductor capacity that exceeds requirements of any lighting layout and with power to spare for other uses. Here's a Channel that adapts to any interval of structural support—may be dropped to any level where it becomes a rigid platform for fixture attachment. Lighting fixtures may be spaced and fastened anywhere along the Channel System.

Branch lighting circuit conductors are completely enclosed in Channel from panel to fixture. This raceway carries full Underwriters' Laboratories, Inc. approval.

MONEY-SAVING FEATURES . . .

● Eliminates Conduit Runs. Eliminates cuttin and threading of conduits for stems ● Uses existing boxes for wiring feeds. Simplifies repair of ballasts ● Easy removal of fixture for cleaning reduce maintenance costs ● Plug in method reduces wiring costs.



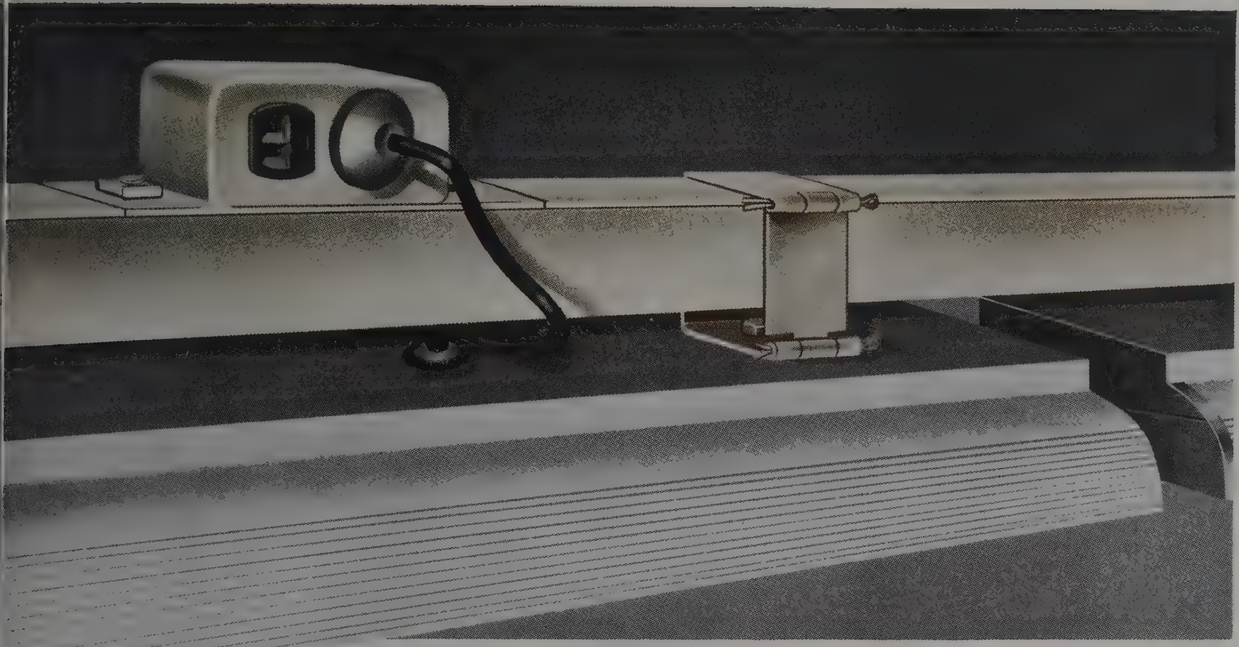
The continuous slot Channel provides complete flexibility of lighting layout. Fixtures may be added or relocated as required. Maintenance costs are reduced by simplified fixture removal . . . merely un-plug cord, open sliding fixture hangers and lower fixture. It's that easy.

Steel City Channel mounts, hangs and feeds the fluorescen fixtures in the lighting modernization of a bank office.

STEEL CITY ELECTRIC COMPANY

A subsidiary of American-Marietta Company

PITTSBURGH 33, PA.



HANGS & FEEDS the fixtures

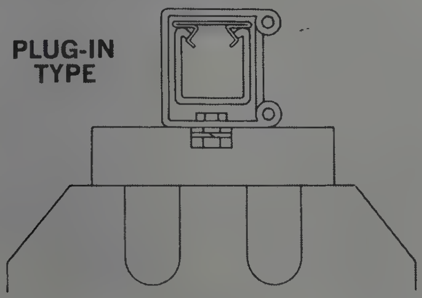
OR SUSPENDED LIGHTING

SURFACE RACEWAY SYSTEMS

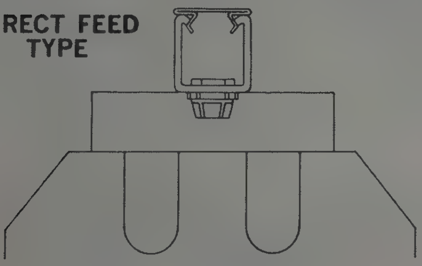
LISTED BY UNDERWRITERS' LABORATORIES, INC.

FIXTURE ATTACHMENT METHODS

PLUG-IN TYPE



DIRECT FEED TYPE



STEEL CITY CHANNELS

Channels of various depths and gauges, for use as surface raceway wiring systems or for fixture support only, are available as standard.

When used as a raceway, the Channel capacities are more than ample for every lighting requirement—up to ten No. 8 AWG conductors (National Electrical Code).

Steel City Channels and accessory fittings are protected by the GALV-KROM finish—an electrogalvanized finish PLUS added protection of zinc chromate. The GALV-KROM process imparts an attractive bronze lustre to the surface which does not require painting.

Steel City Electric Co.
Pittsburgh 33, Pa.

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Company______________________________

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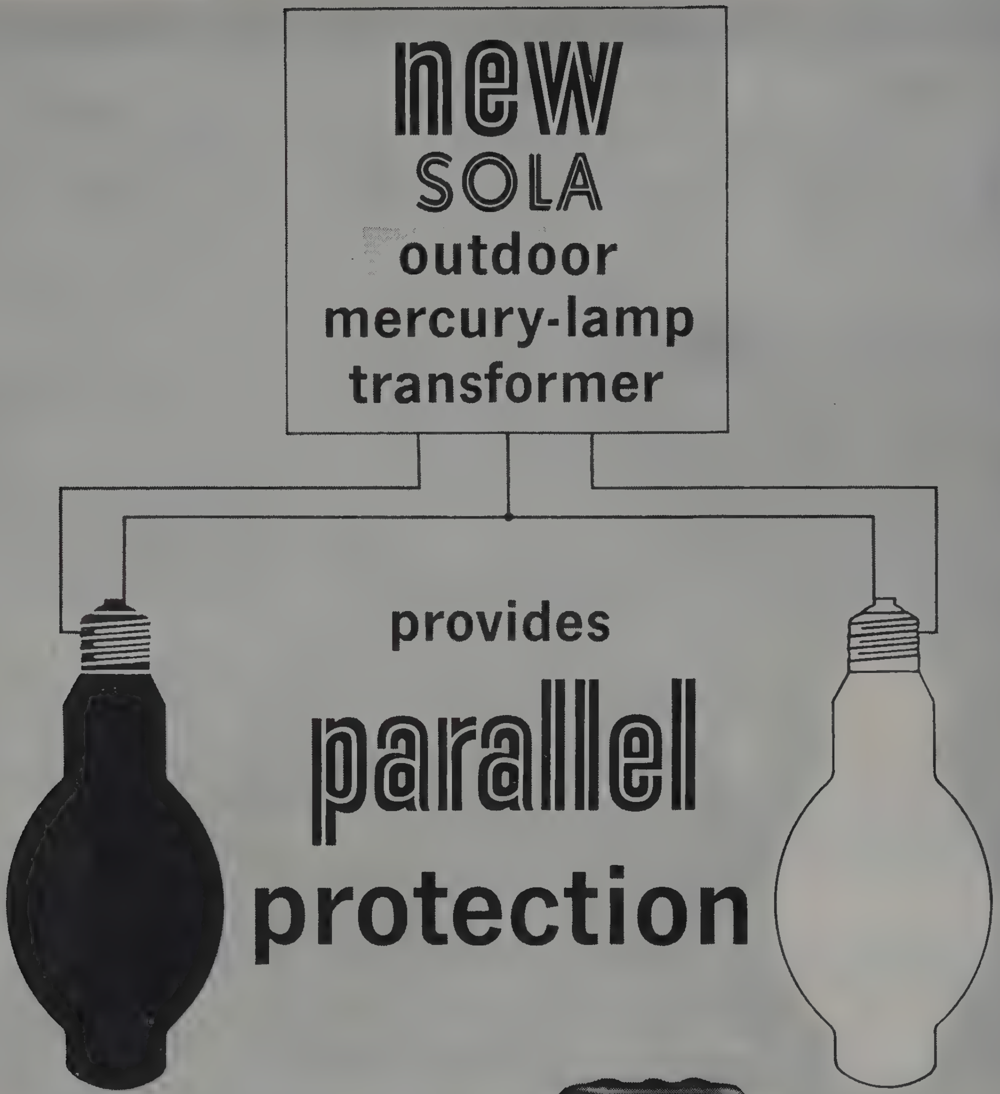


new SOLA outdoor mercury-lamp transformer

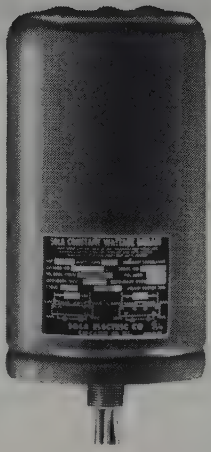
provides parallel protection

. . . plus constant-wattage stability!

Here's the big improvement you've waited for in *mercury lamp ballasting:* a really stable, *parallel-type*, constant-wattage, *2-lamp* transformer. Even if one lamp burns out, this new SOLA transformer keeps the other shining steadily.

And SOLA's *constant-wattage performance* protects both lamps and wiring against surge current . . . forestalls flicker by providing complete electrical independence between paired lamps; also, automatically compensates for line-power fluctuations. And the modest starting demand of SOLA constant wattage allows you to install more fixtures per circuit without having to step up wire sizes. The cost advantages are obvious in such installations as: parking lots, shopping centers, service stations, and dock areas.

Contact your SOLA representative for details on new 2-lamp outdoor constant-wattage MV transformers, as well as the other indoor and outdoor alternative units. Or write for information, mentioning *parallel MV outdoor transformer*.



- "Paralleling" ends double lamp-outages
- Exclusive constant-wattage design holds lumen output within ±1% for line-voltage changes as great as ±13%, assuring full-rated lamp life
- Prevents "drop-out" since input voltage must fall 30% below nominal before lamps extinguish
- Inherent protection against open or short-circuited lamps
- U.L. listed
- Available for 115, 208, 230, 277, 460 and 575-volt input

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BASIC PRODUCTS CORPORATION

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¾" x 30' x .007"
PLASTIC ELECTRICAL TAPE
PLYMOUTH RUBBER COMPANY, INC., CANTON · MASSACHUSETTS · U.S.A.

No.7 SLIPKNOT PLASTIC TAPE IN THREE FLIP 'N CUT SIZES!

NOW, EVERY MAN IN THE CREW CAN CARRY A FLIP 'N CUT because the rolls — and the free plastic dispensers — are tailored TO THE JOB! Costs go down even more with No. 7 Slipknot Plastic Tape on the job, in a size for every need! Cut expense — slash waste — and do every job *right* — with the Flip 'n Cut size the job demands!

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INSTRUCTIONS for the use of this cutter and dispenser on reverse side of insert.
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Cat #3205
¾" x 66' x .007"
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HANDIER THAN AN EXTRA HAND! THAT'S THE FLIP 'N CUT® Slipknot's exclusive dispenser-cutter that stores, dispenses, and cuts the finest plastic tape you can buy. It's FREE with every roll — in 30′ — 44′ — 66′ sizes. Your Distributor stocks it — ask for it by name.

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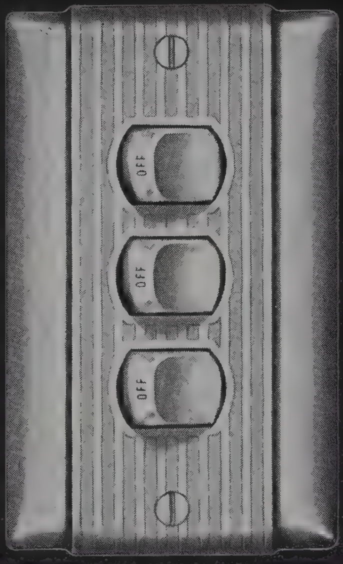
REMEMBER
THE FLIP 'N CUT IS FREE

PLYMOUTH RUBBER COMPANY, INC.
QUALITY SINCE 1896 CANTON, MASSACHUSETTS

P&S means ROCKER-GLO

and 3-WIRE GROUNDING *too! . . .*

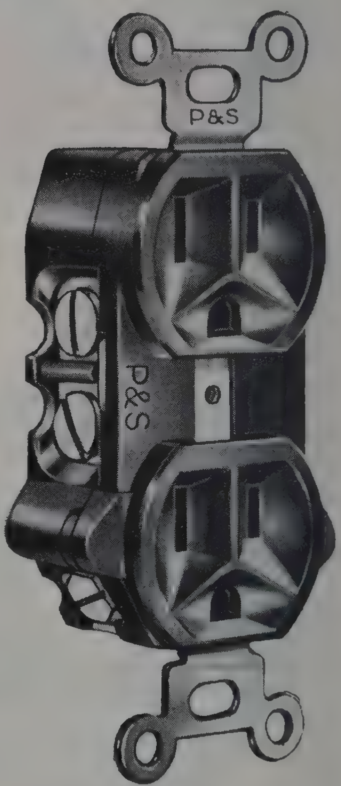


It takes skill and precision to manufacture a switch that has earned the high reputation of Rocker-Glo. This same skill and precision builds the same high standards into *3-Wire Grounding* devices. For heavy duty devices or residential, the P&S trademark is your assurance of top quality, best value in *every kind* of wiring device.

PERFORMANCE SPECIFIED

For information on 3-Wire Grounding

write Dept. ECM 661



5262

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SYRACUSE 9, NEW YORK

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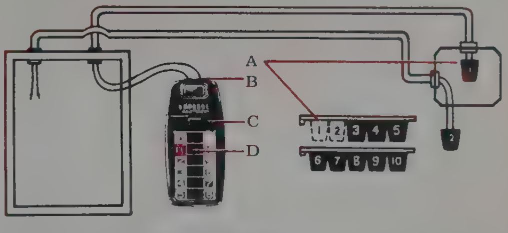
NOW...
ONE MAN
CAN
TRACE
CABLES
FAST!

CABLE TRACER

NOW you can trace conductors in cables and conduit—*10 times faster* than ever before—and leave your helper free to finish other jobs quickly and profitably. A tracing *system* in itself, revolutionary new CABLE TRACER lets you search—and *unmistakably identify*—up to 10 separate circuits simultaneously, even in the dark and when color coding is absent or obscured by age and dirt. It can also test for opens and shorts.

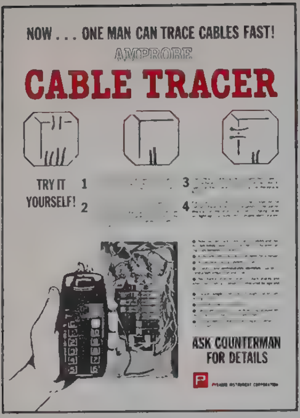
CABLE TRACER is a completely self-powered precision tool which forever eliminates the need for clumsy buzzers. Designed by the makers of famous AMPROBE snap-around test instruments, new CABLE TRACER is simplicity itself to use. At the press of a button, a number lights up to identify the conductor. What's more, CABLE TRACER will pay for itself in saved labor costs after only three jobs. It is supplied with three test leads and ten Station Blocks in a belt-looped carrying case made of top-grain cowhide leather. Test-try CABLE TRACER today; your AMPROBE Distributor has a live-action demonstrator. Or write for free Catalog Sheet CT-10.

only **$\$39^{50}$**



1. Simply plug one end of conductors to be traced into numbered Station Blocks (A).
2. Plug other ends into Receptacle (B) at top of CABLE TRACER.
3. Press Indicator Button (C).
4. The number on CABLE TRACER'S Indicator Panel (D) corresponding to the Station Block at the other end of the conductor being traced (No. 1, in this case) *lights up* to provide identification—instantly, clearly, unmistakably! Using all the Station Blocks, ten conductors can be traced at one time.

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, NEW YORK *Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto, Ont.*


NOW . . . ONE MAN CAN TRACE CABLES FAST!
AMPROBE
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2
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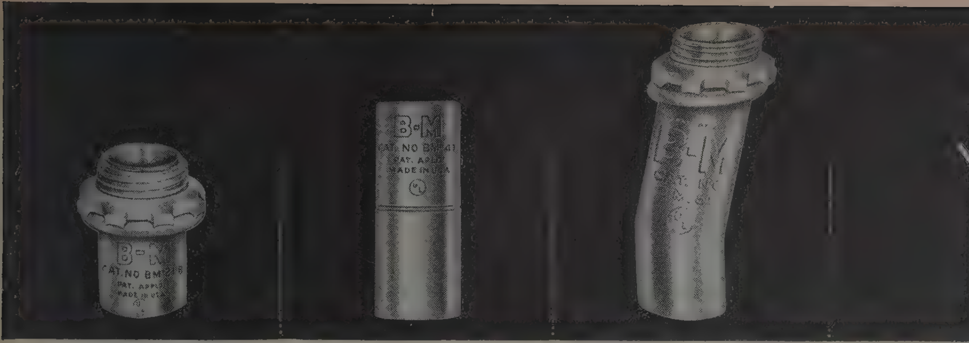

Red Throat
BM-21B
½" Connector
BM-22B
¾" Connector
BM-23B
1" Connector

BM-41
½" Coupling
BM-42
¾" Coupling
BM-43
1" Coupling

BM-51
½" Offset Connector
BM-52
¾" Offset Connector

BM Offset
Connectors
showing how
wires are
guided over
box edge.

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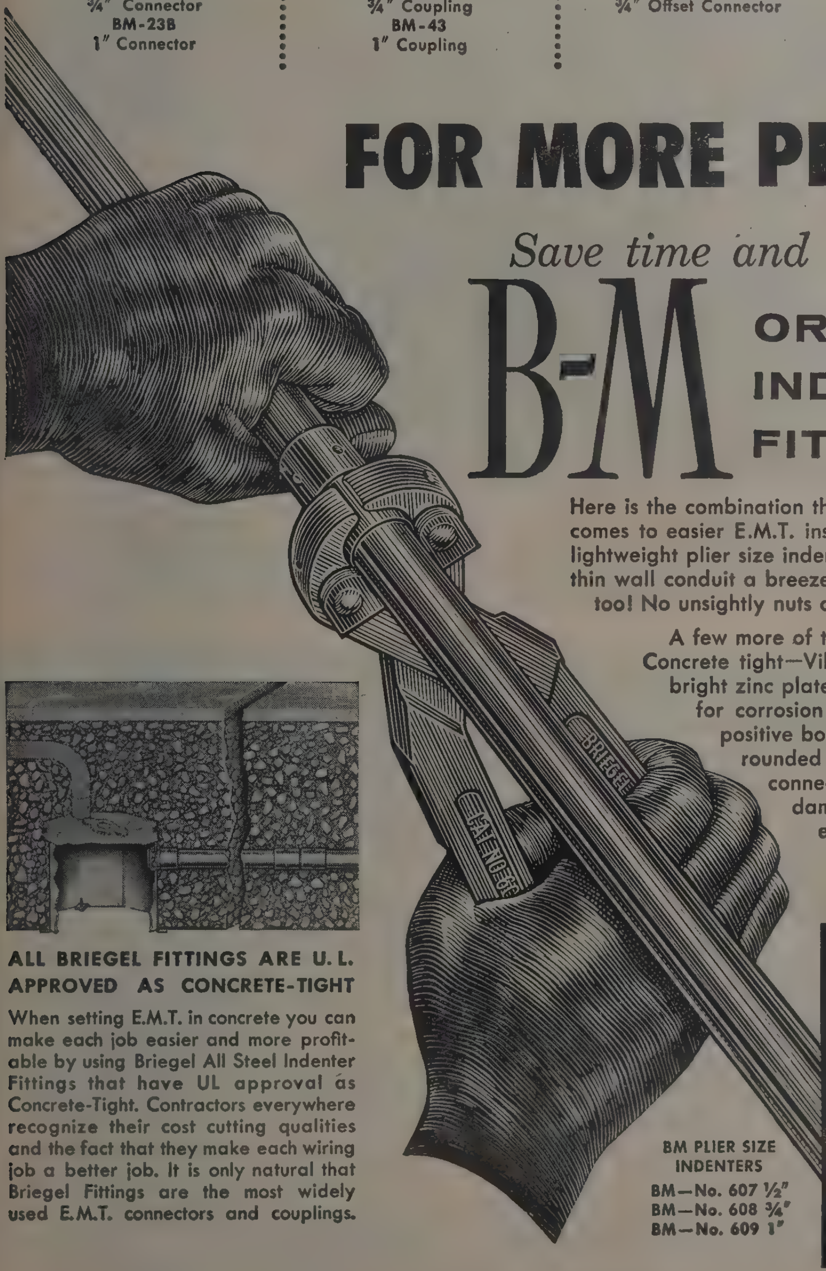

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INDENTERS
BM—No. 607 ½"
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BRIEGEL METHOD TOOL CO.
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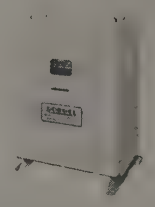
USED THE MOST FROM COAST TO COAST

QUIET QUALITY The Symbol of Specialization

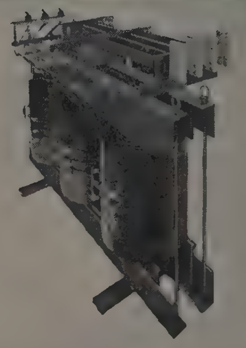
Shown discussing the customer merits of a newly installed 112½ KVA Sorgel Dry-Type Transformer are Mr. Richard R. Pooley, Facilities Manager of Tektronix, Inc.; Mr. Jerry Jones, General Superintendent, W. R. Grasle Company, Electrical Contractors, Portland, Oregon; and Sorgel Sales Engineer, Mr. Henry C. Lehl. This transformer is installed in Tektronix's main facilities at Beaverton, Oregon. The Contractor commented on the fast installation of Sorgel units because of knockouts on all sides and easy accessibility to terminal connections.

SORGEL HAS A DRY-TYPE

1/4 KVA
TO
10,000 KVA,
ALL STANDARD
AND
INTERMEDIATE
VOLTAGES
UP TO
15,000
VOLTS



Popular sizes up to 75 KVA, both single and 3 phase transformers, are normally in factory stock. They are also constructed to be interchangeable for wall or floor mounting.



The transformer is the heart of your entire electrical system. Here is where true quality gives you dependability and low cost operation. Illustrated is a 500 KVA, 5 KV class, for a Sorgel unit substation.

If you BUY, SPECIFY or INSTALL transformers, YOU SHOULD KNOW THESE IMPORTANT FACTS

Here Are Eight Sorgel Customer Benefits That Mean Positive Savings in Dollars

These engineered advantages show why Sorgel dry-type transformers are considered the finest in the electrical field. These quality features, and many others, assure you of economy in installation and operation.

- All coils have end filler protection in each layer to prevent movement of conductors under heavy loads and short circuit stress conditions.
- The transformer core and coil unit is specifically designed for low sound level. In units 15 KVA and larger, the core and coils are mounted on vibration dampening pads designed to suppress transmission of vibration to adjacent areas.
- Each unit is completely assembled, wired, and tested at the factory, ready for line and load connections eliminating any job-site assembly.
- All terminations are securely anchored, and solderless connectors are furnished on all transformers with terminal boards. Vacuum impregnated windings are brazed to the terminals.
- Connection covers are cushioned and easily removed by means of two captive bolts on small sizes, and four on larger sizes.
- Ventilating openings are designed to prevent accidental access to live terminal parts. Expanded metal is not used on sides, back or front.
- In Quiet-Quality units, performance data, such as core loss, copper loss, sound level, etc., is always equal to, or lower than, the guaranteed values submitted to the customer.
- Sorgel units are individually tested in accordance with NEMA standards. Certified tests are furnished upon request, to further substantiate the guaranteed data.

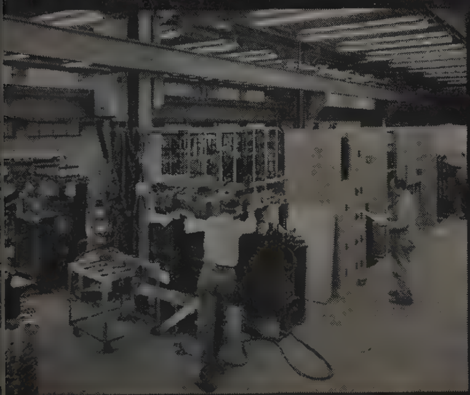
Contact your nearest Sorgel Sales Engineer for additional reasons why Sorgel units are truly your most economical buy - as quality pays, it doesn't cost.

SORGEL SOUND-RATED DRY-TYPE TRANSFORMERS

SORGEL ELECTRIC COMPANY

Since 1916 the pioneer in the development, manufacturing
and application of sound-rated dry-type transformers
836 WEST NATIONAL AVENUE • MILWAUKEE 4, WIS.
Experienced sales engineers in principal cities

TRANSFORMER FOR YOUR EVERY NEED



CLIP AND MAIL FOR TECHNICAL BULLETINS.

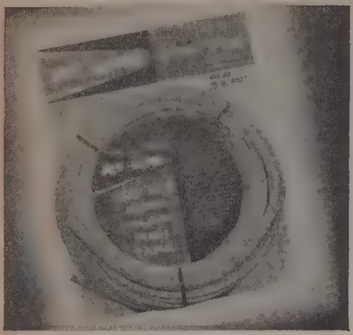
☐ 611—Transformer Line
☐ 960—Substations
☐ 658—DC Saturable Reactors

Name__________
Title__________
Address__________
City__________
State__________

All units are built to meet or exceed latest standards of ASA, NEMA and AIEE. Sorgel provides the most liberal designs and a coordinated system of either Class B, F or H insulation with the most effective use of quality materials to assure continuity of service.

Every Sorgel product is carefully packaged to provide maximum shipping protection and ease of handling. Pallet mounting and easy-to-use lifting eyes on sizes 2 KVA and larger really mean fast installations.

Products for wiring any size, any type, any length conduit



Replaces metal fish tape

Use *Jet Line Rigid Rope* and do away with fish tapes—it's safer, faster, costs less too! Non-conductor, easy to grip, strong, durable, lightweight. Won't rust or corrode. Available in 50′ and 100′ lengths, with Guide Sleeve.

Wire small I.D. conduit fast

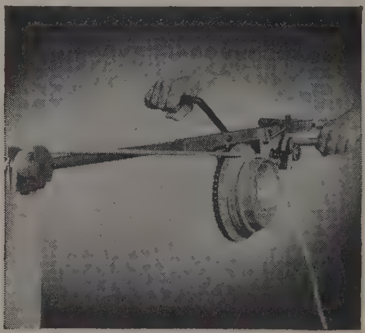
The *Jet Line Cylinder* makes short work of installing pull lines in ½″, ¾″, and 1″ I.D. conduit . . . does the job in seconds, regardless of length, bends. Actually clears mud and water. Safe, quick, sure—can pay for itself on one or two jobs!

Pull wire in minutes, not hours

Use the *Jet Line Gun* in conduit 1¼″ thru 6″ I.D. Rugged, pocket-sized, positive action tool launches a tiny CO2 cartridge that wiggles through conduit laying nylon line — up, down, around bends. Runs up to 600 ft. Use nylon line to pull Poly Rope, then wire, in minutes!

Recharge Jet Line Cylinders

The *Jet Line Refill Unit* enables contractors, utilities, industry to refill Jet Line Cylinders from 50 lb. CO2 supply tanks at warehouse, shop, or job. Saves time and cuts the cost of Jet Line Gas.

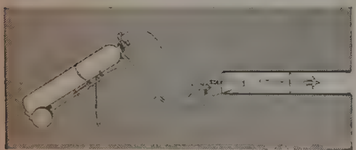


No-strain wire pulling

Jet Line Wire Puller equals 6 men pulling by hand. Constant 20 to 1 ratio—no variation of power, no limit on length of run. Will not tangle rope. Weighs only 12 lbs., grips anywhere on pipe. Use with 5/32″ thru ⅜″ Poly Rope.

Safe, strong, low-cost pull line

New synthetic *Jet Line Poly Rope* is rapidly replacing heavy, dangerous steel cables for pulling wire through conduit. Non-conductor; strong, lightweight, pulls easily, will not corrode or absorb water. Available 5/32″ thru ¾″ dia. on spools or take-up reels—strengths to 8000 lbs.



Wire underground runs to 1500 ft.

With Jet Line Underground, one man can put a line through underground conduit (1¼″ thru 4″) in seconds! Clears mud, water, loose objects—eliminates rodding and snaking. Handy for large I.D. pipe in long runs. Low-cost CO_2 power, available everywhere.

New JETMASTER makes you a ONE-MAN GANG for all conduit wiring jobs

Now the entire Jet Line Method is combined into one handy, compact, easily portable unit — the all-new JETMASTER. Wherever you go with JETMASTER, you'll have all the Jet Line tools and accessories immediately available for installing pull lines in any size, any type conduit — easily, quickly, safely.

JETMASTER contains Jet Line Poly Rope, Rigid Rope, assortment of line packages, line cones, etc., the Jet Line Gun, plus 20 lbs. of CO_2 power and 3 seal-offs — for doing the work of both the Jet Line Cylinder and Jet Line Underground.

For full information on RIGID ROPE, and the complete Jet Line Method of wiring conduits, ask your distributor or write

JET LINE® PRODUCTS, INC.

305 Foster Ave., Charlotte 3, N. C.

5617

©1961 VOLKSWAGEN OF AMERICA, INC.

Our dealers have had parts for our '62 model for years.

Yes. Our '62.

Next year's Volkswagen.

Doesn't it stand to reason?

We make only the one basic truck. We've been perfecting it for the past 12 years. Part by part.

Today practically every part is improved. Yet most fit any year VW you have.

The number of parts we take from Volkswagen production as spares would seem excessive to some manufacturers.

But VW service is as much a part of the idea as the VW price or the VW gas consumption.

Our dealers carry spares they almost never get calls for. Axles. Wheels. Even dip sticks. As a rule, this makes VW repairs much faster than other makes.

(Other dealers simply can't afford the spares for every year and model that a VW dealer carries for just one truck.)

This has become very important to people with '51 and '52 VWs. They can still get a rear quarter panel, a gas pump or a cylinder head in no time.

We're still making them for those years.

(And those years look like our '62, too.)

New General Electric appliance
–with neat, easy-to-wire

Here is the full capacity of attractive appliance

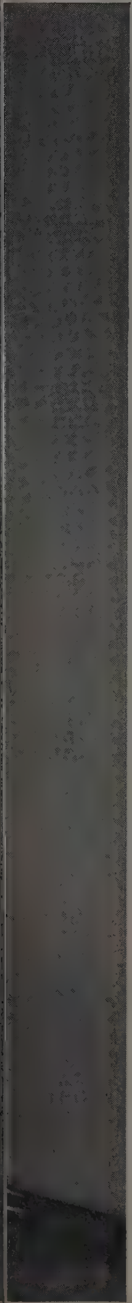
FOR JUST A FEW DOLLARS, YOU GET TWO deluxe, double 20A, 125V grounding outlets — **plus** a welded box — **plus** an attractive Decorator Wall Plate — in this new G-E Appliance Center.

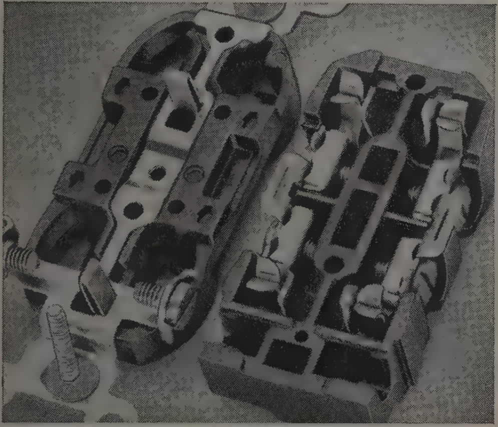
You just mount the device and connect it to a 3-wire, 120/240V branch circuit to get two 20A circuits.

The General Electric Appliance Center is rated at 20A, 125V for each outlet; provides 4800 watts @ 120V. U.L.-Listed; meets Federal and REA specifications.

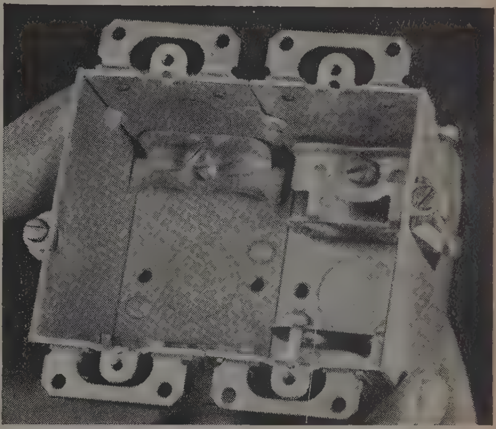
center gives you two 20A circuits
low-cost "package"

centers at a fraction of the cost!

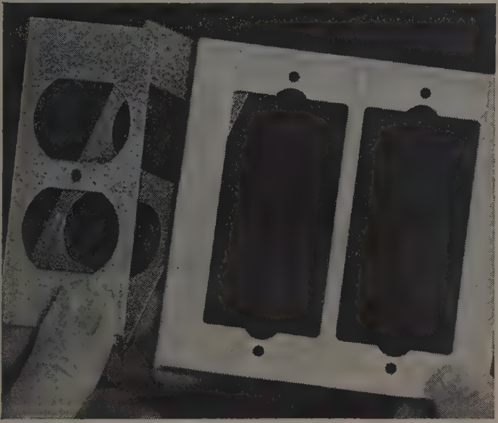




YOUR G-E OUTLETS are of highest quality, with double-wipe contacts, clamp-type, back-wiring terminals. They accept 20A or 15A grounding and polarized-parallel caps, as well as parallel-pronged caps.



YOUR 2-GANG, WELDED BOX comes with cable clamps for metallic and nonmetallic sheathed cable; knockouts for rigid or flexible conduit. 3¾" wide x 3" high x 2½" deep.



YOUR G-E DECORATOR WALL PLATE has an ivory frame and two reversible, gold/silver colored metal inserts; plus clear plastic inserts, to go over wallpaper or fabric customers can add to match walls.

YOU PLEASE CUSTOMERS with this neat, attractive new device, because it provides 4800 watts of power in one spot—supplies up to four portable appliances, without blowing fuses.

Ask your General Electric distributor to show you this new GE4106-2 Appliance Center — and the many other new G-E devices that save you money and simplify installation. General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

Progress Is Our Most Important Product

GENERAL ELECTRIC

What it is

The business end of a powder-actuated tool, made by Ramset Fastening System. It's called the Duo-Jobmaster.®

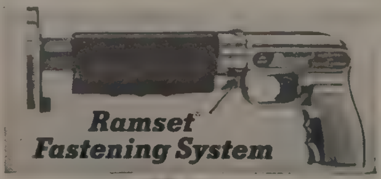
What it does

Makes fastenings to steel and concrete. You can attach furring strips to concrete in less time than it takes to tell about it. Or to steel. Sprinkler pipes too. And door bucks. Curtain wall brackets. Heating ducts. *Almost anything.*

The fastenings are made with male or female threaded studs. Or with drive pins (nails). Over 140 different fasteners are currently available.

How it does it

The fastener and a 22 calibre blank cartridge are inserted in the tool. A squeeze of the trigger and the fastener is in. This includes studs and drive pins that are over 4 inches long! Numerous interlocks prevent it from being operated prematurely. And easily interchangeable barrels convert it from 1/4" to 3/8" work.



What it saves you

Time, money, effort. No time consuming drilling or plugging is required. There are no expansion bolts to insert. In some cases fastenings can be made every 15 *seconds.* Others take a little longer.

Five years of extensive use by contractors have shown that the fastenings made by this tool are at least the equal of those made by any other method. But it makes them faster and with vastly less effort. It's made by Ramset and it's the finest powder-actuated tool in existence.

Write for more information or call your local Ramset dealer. He's listed under "Tools" in The Yellow Pages.

WINCHESTER-WESTERN DIVISION Olin 285F Winchester Ave., New Haven 4, Conn.

Rigid steel conduit protects wiring permanently

Rigid conduit in steel is the strongest answer to your electrical raceway problems. And that's proved by more than 50 years of dependable wiring protection.

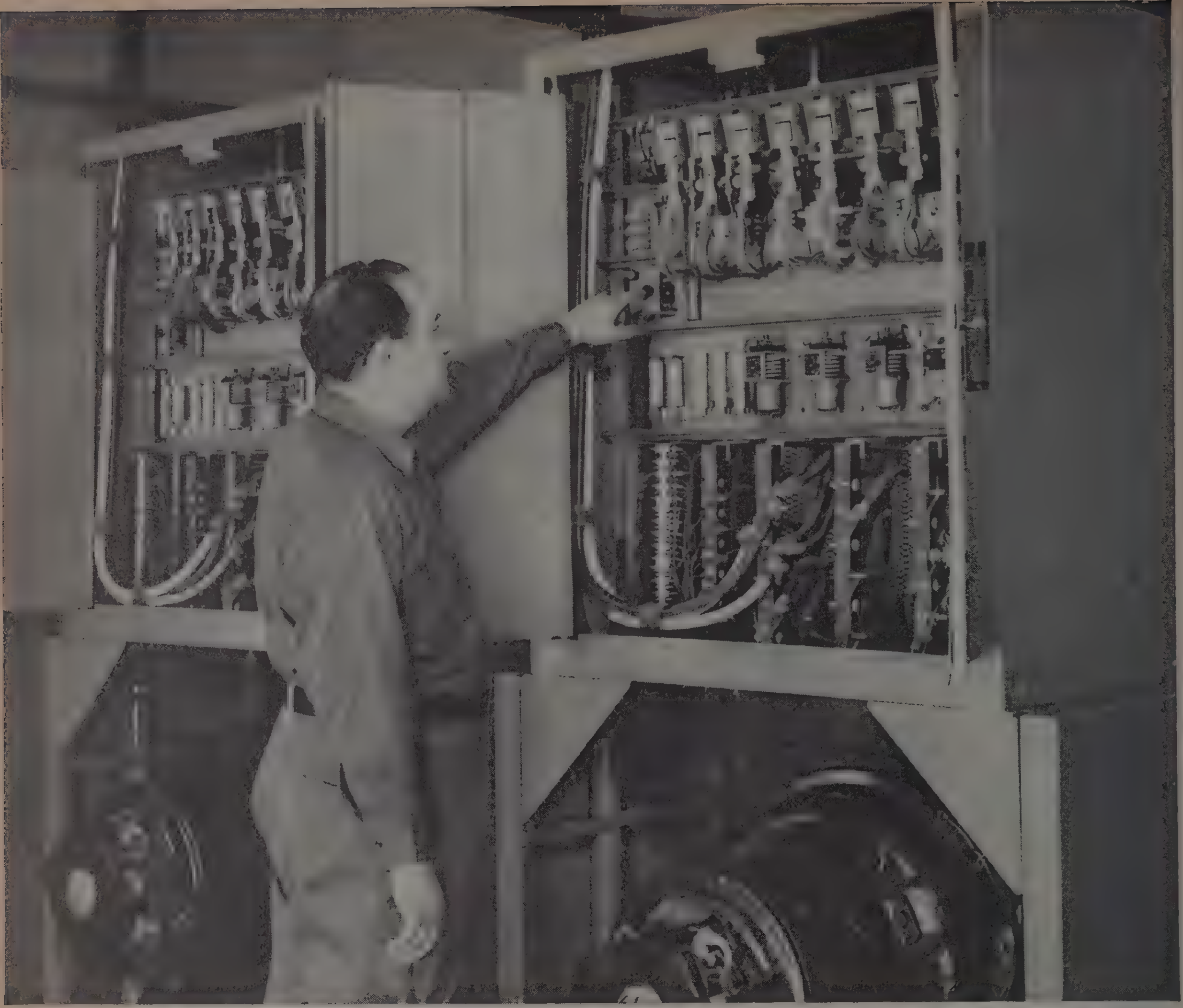
Before you specify your next job, ask your electrical distributor for comparative details. Or check with leading manufacturers of steel electrical conduit, many of whom build their products from Bethlehem steel—EMT from Bethlehem steel sheet; rigid conduit from Bethlehem steel pipe.

Steel
for Strength
.. Economy
... Versatility

Bethlehem Steel Company, Bethlehem, Pa. *Export Sales: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

BETHLEHEM STEEL



THW building wire, insulated with Bakelite vinyl, easily copes with the heavy current load required to power DC elevator generators. It is listed by Underwriters' Laboratories for 75 deg. C. service in either wet or dry locations.

THW Wire insulated with BAKELITE® Vinyl meets the demand for greater current carrying capacity

THW building wire insulated with quality Bakelite Brand vinyl permits greater current carrying capacity in the same conductor size . . . just one of the many ways in which Bakelite vinyl offers electrical contractors and engineers increased economy and convenience.

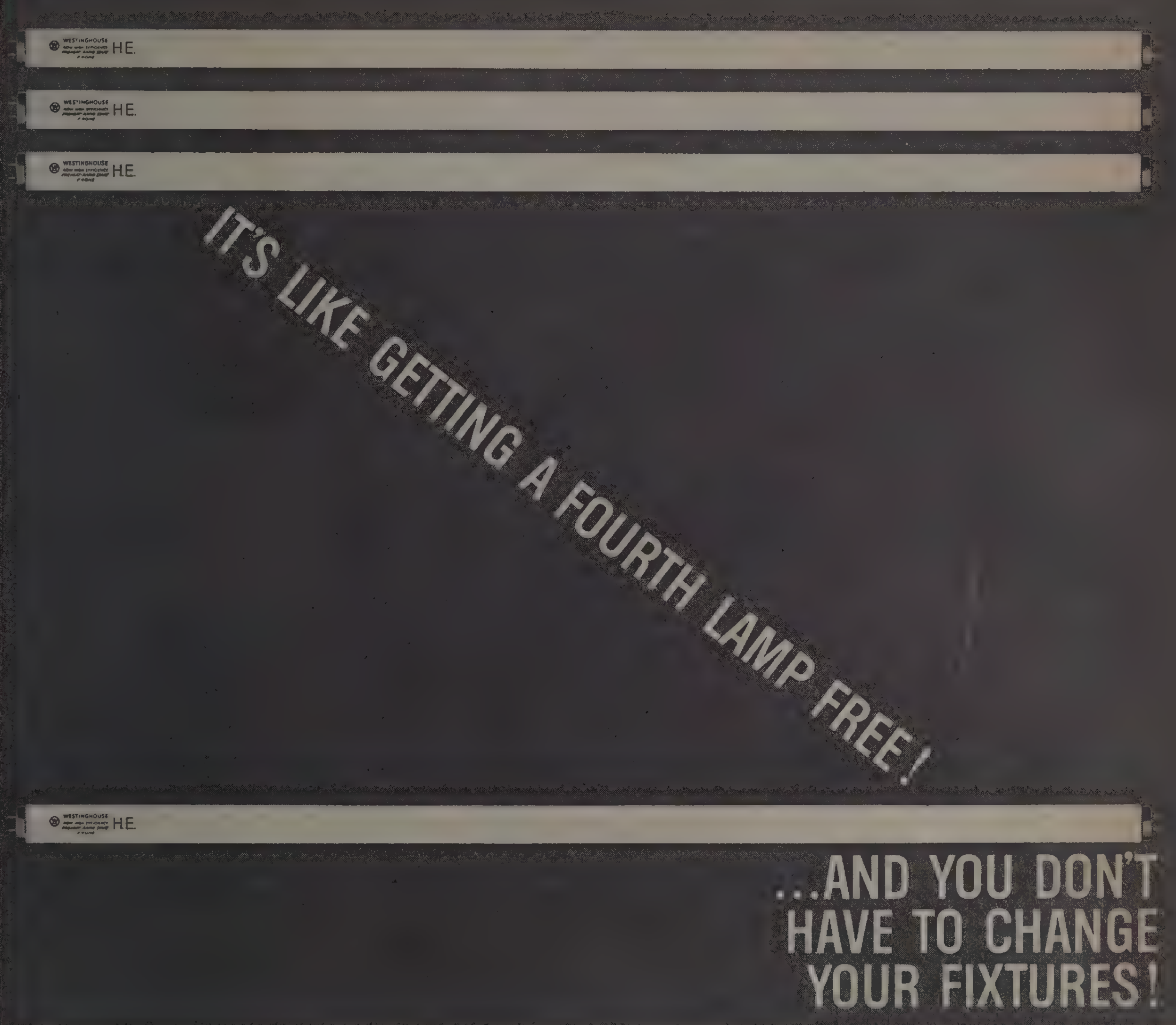
The higher heat resistance of THW wire insulated with Bakelite vinyl also provides greater protection against heat generated by overloads and high environmental temperatures and permits the use of thinner insulation on larger conductor sizes, thereby allowing the use of smaller conduits or increased circuits in existing ones.

Easier stripping, splicing and pulling through conduits is provided by the smooth, uniform insulation of vinyl on THW wire . . . leading to faster, neater wiring operations.

Along with these benefits, insulation of Bakelite vinyl is tough, withstands abrasion and rough handling, and possesses superior resistance to moisture and most chemicals. For more information on why you should specify and use THW building wire insulated with quality Bakelite vinyl, write today to Dept. KC-41F, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

Bakelite and Union Carbide are registered trade marks of Union Carbide Corporation.


H.E.
H.E.
H.E.
IT'S LIKE GETTING A FOURTH LAMP FREE!
H.E.
...AND YOU DON'T HAVE TO CHANGE YOUR FIXTURES!

NEW WESTINGHOUSE HIGH EFFICIENCY LAMPS GIVE YOU 1/3 MORE LIGHT AT NO EXTRA COST!

YOU'RE LIGHT-YEARS AHEAD WITH WESTINGHOUSE... and the brightest, most economical fluorescent lamps you can buy! Now you can increase lighting levels without changing a single fixture... without increasing power costs... and without paying premium lamp prices. New Westinghouse "High Efficiency" fluorescent lamps give you a full third more light than daylight lamps.., and 15% more light than cool white lamps... without consuming an extra watt of power!

"H.E." lamps are so new even the color tint is different—and only Westinghouse has it! A special blend of phosphor particles coating the inside of each lamp provides the higher lumen output... with a pleasant and restful green tint. Users everywhere feel this new green-white light gives a softer, more comfortable light... the most efficient light yet. Try "H.E." lamps in an entire area. If you don't agree that they provide the most efficient light ever, we will gladly exchange them for any Westinghouse fluorescent, any color shade, of your choice!

With "H.E." and other Westinghouse lamps, the Westinghouse Lighting Cost Reduction Plan gives you one or more of these benefits:

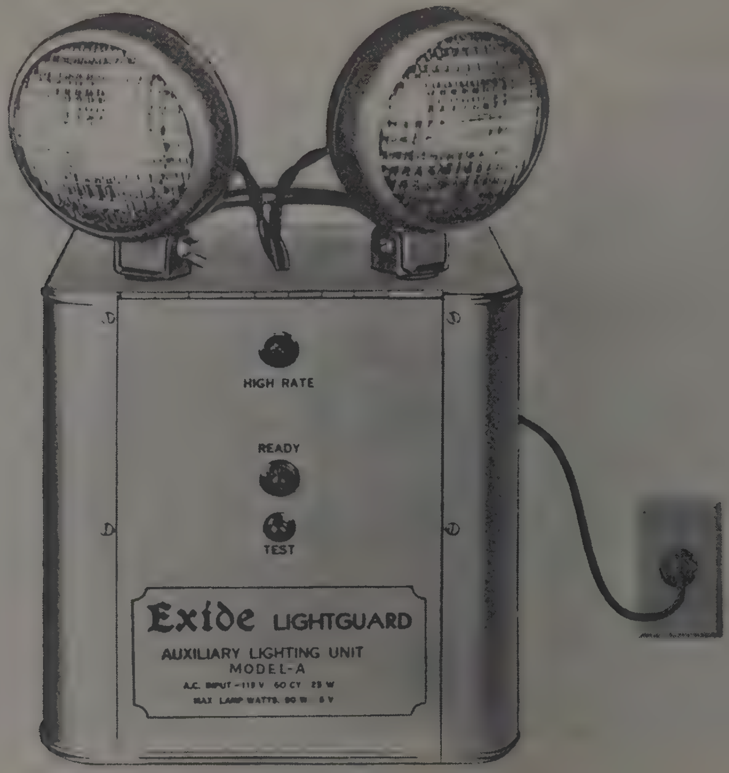
1. **Reduced cost of lamp purchases!**
2. **Reduced lamp replacement labor costs!**
3. **Increased lighting level for the same or lower costs!**
4. **More efficient use of power!**

Order new Westinghouse "H.E." lamps today and get more information on the Lighting Cost Reduction Plan from your authorized Westinghouse Lamp Agent or your nearest Westinghouse Lamp Sales Office! *You can be sure...if it's Westinghouse.*

Westinghouse

Westinghouse Lamp Division, Westinghouse Electric Corporation, Bloomfield, New Jersey

WHEN LIGHTS GO OUT . . . LIGHTGUARD GOES ON INSTANTLY AND AUTOMATICALLY



Most popular model. Completely automatic. Features Exide rechargeable battery and fast acting 2-rate charger. Available for one, two or three lamps.

ALL EMERGENCY LIGHTING UNITS AREN'T ALIKE!!

Exide Lightguard® uses sealed beam lamps, just like your car. It never loses its brightness, even in a corrosive atmosphere. Powered by a special long-life Exide battery of same type as used by electric utility companies for power control. Gives you extra hours of light when you need it . . . extra years of economical life. Built-in charger automatically brings battery back to capacity after each use and keeps it there. No time clock needed. Exide Lightguard is easy to install. Plug into regular a-c outlet. When power fails and regular lights go out, Lightguard goes on instantly and automatically. See Exide Lightguard at your nearby electrical distributor's. Or write for literature. Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

Dry cell model

◀ Most economical to buy. Same lamp brilliance as storage battery model. Uses standard dry cells, available everywhere.

To cover larger areas ▶

New Model E. Three times more battery capacity. New fast-acting 2-rate charger can handle up to five brilliant lamps.

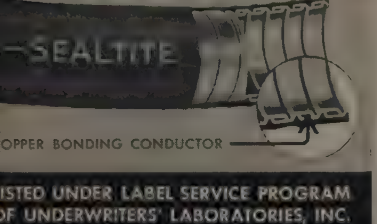
Exide®

INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company (ESB)

TEAM IT! SHAKE IT! SOAK IT!

But be certain you have the original Sealtite
exible, liquid-tight conduit. Only Anaconda makes it.

itation is the sincerest form of flattery. t unless you install flexible, liquid-tight conduit that's plainly *marked* "Sealtite" and "Anaconda" on the jacket, you have an imitation.



ISTED UNDER LABEL SERVICE PROGRAM
F UNDERWRITERS' LABORATORIES, INC.

AWAY SECTION of Type U.A. Sealtite ws tough polyvinyl chloride jacket over flex- metal core. Copper conductor wound spi- y inside conduit provides positive ground.

What difference does it make? Only genuine Sealtite gives you the assurance that your flexible conduit meets the highest standards of quality set by Anaconda. Every piece! Every foot! Where even one failure can mean costly downtime and repairs, it pays to be certain that you get what you order: the original, genuine Sealtite flexible, liquid-tight conduit by Anaconda!

WHERE TO GET SEALTITE—Electrical Wholesalers stock Sealtite in easy-to-handle coils, in black or gray. Buy it in long lengths on reels or in cartons and cut it on the job without waste. Your wholesaler also stocks liquid-tight connectors.

Free booklet S-542 gives full information on Sealtite. Write: Anaconda Metal Hose, P. O. Box 791, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Sealtite is approved by Canadian Standards Association.

61147

SEALTITE®

FLEXIBLE, LIQUID-TIGHT CONDUIT

an ANACONDA® product

Beautiful Floors

remain beautiful with T&B Floor Boxes

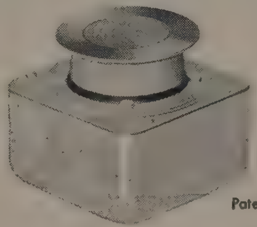
add the beauty of burnished bronze to tile, terrazzo, linoleum or concrete floors

With the exclusive construction of T&B floor boxes, all unsightly screws are concealed, leaving only the polished bronze cover plate visible. Concrete tight...levels 10° in any direction... adjusts 5/8″ vertically.

Designed for easy installation, with a variety of interchangeable accessories and receptacles.

Patent Pending

CAT. NO. 1753
REDDY-TILT FLOOR BOX — SHALLOW FILL



Patent Pending

CAT. NO. 1754
REDDY-TILT FLOOR BOX — NORMAL FILL

T&B ENGINEERED

THOMAS & BETTS

THE THOMAS & BETTS CO.
INCORPORATED
ELIZABETH 1, N. J.
IN CANADA, THOMAS & BETTS LTD MONTREAL
GENTLEMEN: PLEASE SEND ME BULLETIN NO. F13-144

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60TH YEAR • JUNE 1961

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Code Rules for Swimming Pools

The special technical sub-committee on underwater swimming pool lighting reported to the NFPA Electrical Section last month recommending the grounding of submerged fixtures by means of a separate copper grounding conductor. The recommendation is expected to be incorporated in the next edition of the National Electrical Code. No recommendation was made regarding low-voltage installations which were relegated to a minority report.

Compliance with the NEC, it says, "will result in an installation essentially free from hazard." The code heretofore had no special provisions for underwater lighting and the broad assurance could be hedged. Now that a formal committee has given its considered recommendations after a study of the problem, the line voltage, wet-niche, swimming pool installation now carries code endorsement as "essentially free from hazard." This is a grave responsibility.

In the face of known records of five fatalities and unquestionably many more in which the cause of death was drowning from paralyzing but nonfatal electric shock, it is extremely doubtful that the improved grounding recommendations even come to grips with the basic problem. In submerged, line-voltage installations, minor defects in equipment, invisible errors in installation, ordinary wear and tear, and well-meaning but inexpert maintenance, all of which might be harmlessly insignificant in other environments, are potentially lethal in the home swimming pool.

A vital shortcoming in the task committee's report was its evident failure to recognize that submerged swimming pool lighting presents a unique hazard. Not only is the swimmer exceptionally vulnerable to shock due to lower skin resistance, but he is immersed in a conducting medium. Thus, if lethal voltages are used, exceptionally rigorous precautions must be taken against even the slightest leakage or exposure of current carrying conductors or parts.

Low-voltage swimming pool lighting, which the committee majority chose to ignore, deliberately provides a system which is inherently safe from fatal shock hazard. No lethal voltage is available in the fixtures or its associated wiring. No exceptional precautions are necessary. While good maintenance is desirable, and necessary for effective lighting, carelessness or abuse can not result in a hazard to life.

Some excellent 12-volt equipment is already on the market. More will surely follow if code authorities take a sterner view of the hazards of line-voltage installations in home swimming pools. And contractors ought to be able to look to the code for approved wiring and installation standards more specifically devoted to the special considerations of this type of work.

We think that thoughtful code authorities are very much disappointed with the task committee's recommendations. Underwater line-voltage lighting in swimming pools needs the strictest regulations as to installation plus periodic inspection and testing if it is to be classed as "essentially free from hazard." Half-measures won't do. For home pools, the low-voltage installation is the only responsible solution.

Wm. T. Stuart

KNOW YOUR SYMBOLS

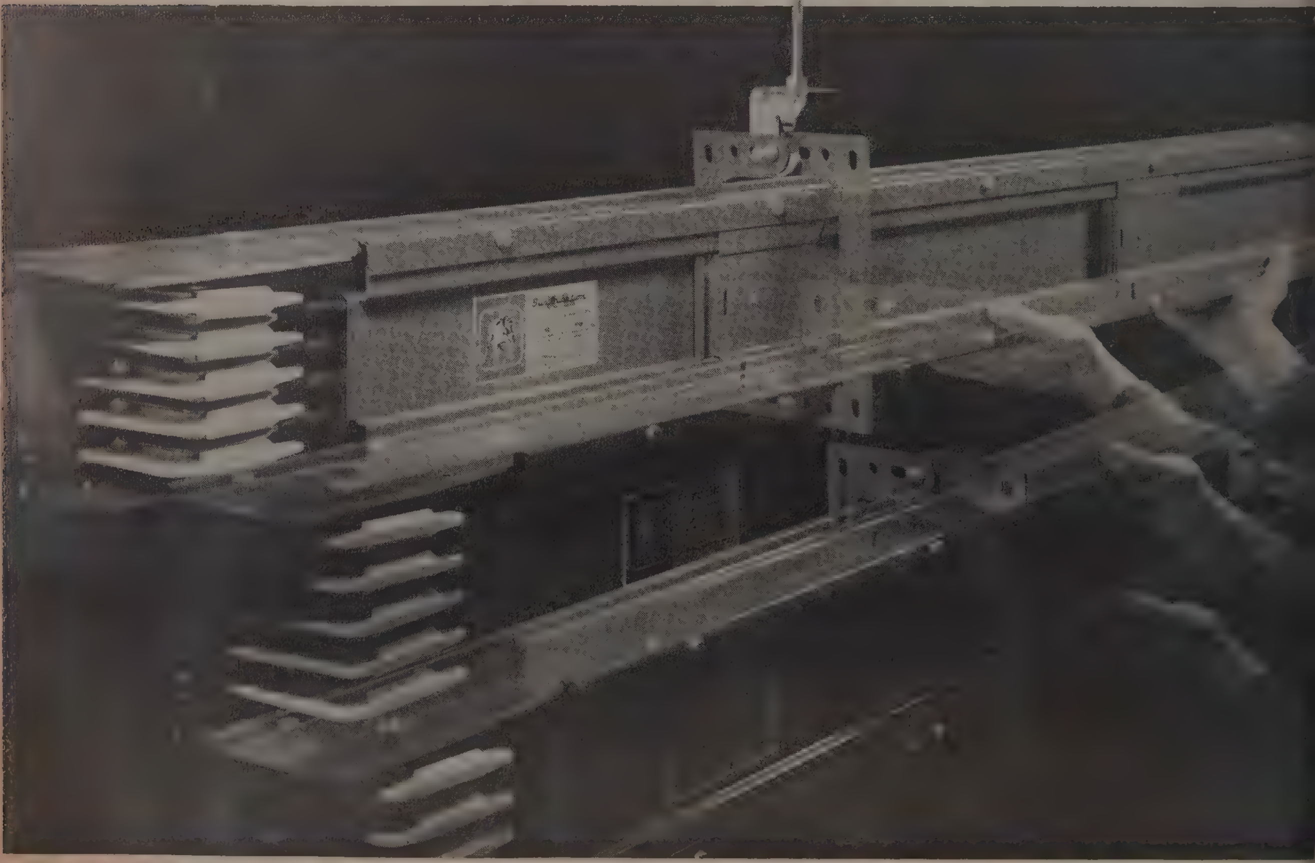
This symbol stands for bus duct

This symbol stands for QUALITY

NOW... BullDog plug-in duct hangs up to 50% faster

with new HANGFAST Adapter

New HANGFAST Adapter bolts quickly and tightly to suspension rod end . . . duct with standard hanger engages HANGFAST Adapter hook instantly . . . hanger bolt spins tight fast for a lasting, secure installation. Result—you can save as much as 50% in hanging time . . . end time-consuming bracket fabrication, too! And you can use the new HANGFAST Adapter with all types of BullDog industrial plug-in duct systems—XL, BD and LO-X®. Ask your BullDog Field Representative for a demonstration. Or write for details.



BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Mich. In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 East 40th St. New York 16, N.Y.

I-T-E CIRCUIT BREAKER COMPANY

BULLDOG ELECTRIC PRODUCTS DIVISION

ELECTRICAL
CONSTRUCTION
AND MAINTENANCE

Revolutionary concept uses . . .

Economical On-Site Electric Generation

for "compact" buildings

Local generation of electric power is a vitally-integrated element of a new gas-turbine energy pack which provides substantial economy in serving the power, light, air-conditioning and heating needs of modern, windowless commercial and institutional buildings with controlled evironments.

By Dana Price, *Electrical Engineer, Goleman & Rolfe, Architects & Engineers, Houston, Texas*

WIDESPREAD use of local power generation for modern buildings might very well prove to be the most significant electrical system development in many years. As a result of much study and several actual installations, it appears that gas-turbine local electric generation may be the key to an electro-mechanical plant which will best satisfy the light, power, air-conditioning and heat needs of many modern, controlled-environment buildings. To date, indications are that both first cost and operating cost of compact, closed, windowless buildings can be minimized by use of gas-turbine plants providing controlled light, temperature, humidity and ventilation.

From the standpoint of electrical system design, local generation of power frees the designer from the usual limitations imposed by the relatively inflexible character of utility supplies. With local generation, choice of supply characteristics—selection of one or more voltages, use of ac at one or more frequencies, use of dc—can be closely correlated to the nature and requirements of each installation by selection of the proper generators. This factor in itself can be translated to clear and practical economies in first cost and operation. Elimination of special converters for high-frequency lighting or power applications or elimination of large capacity rectifiers can be a big first cost item. And the ready availability of special frequencies or dc makes possible the operating economies of high-frequency lighting, dc speed control or other applications where other than 60-cycle operation offers advantage.

Use for Schools

One of the most important applications for this new approach is in schools. In school buildings, all of the advantages of the new system mesh particularly well with the power, light and air conditioning needs of the occupants. The over-all approach involves the following considerations:

A new secondary school is emerging throughout the nation today. It is the compact school. This school is quite different from those built five years ago and is not restricted to any particular area of the country. The reason is that the school contains its own climate and environment for learning.

Recent research has provided the background for the development of this new type of secondary school. The concept was new because by definition the school had to solve educational problems hitherto unsolved, and it had to do it with style, good taste and true economy.

In order to meet the demands of a better secondary school, architects and engineers had to break with the conventional concept of school design. The age-old concepts that ventilation had to be provided by natural means through windows and doors and that light would be provided naturally through windows, augmented by artificial light, proved to be entirely too expensive to meet the demands of true economy. The old concepts of light and ventilation for years had forced the 30-pupil classroom, spread out buildings, extended utilities, and in general, extremely expensive construction.

Once accepted that it was necessary to break with the old concept, an entirely different type of school began to emerge. The school made better use of site, was independent of orientation, provided a much better plan that was much simpler to administer. It met the educators' demand that classes be sized according to need instead of a uniform size. It further provided that some rooms be flexible to allow for daily changes and that the over-all structure be planned so changes in the building could be made inexpensively.

Ideal Environment

This school had an independently fresh look. New materials and textures were used to make it interesting. Halls were 20 ft wide with interesting murals, dioramas, and brightly colored lockers of mixed colors. Changing art displays and lighting intensities, colors, and schemes gave birth to a feeling shared by student and teacher alike that here was an atmosphere that provided an ideal environment for living and learning.

Year-round control of the air cleanliness, ionization, moisture, temperature, motion, ventilation, and light provided other by-products. Outside noises no longer interrupted study or classroom activities. Noisy areas such as shops, gymnasium, cafeteria, and typing rooms presented no problems of control because windows were not required in these areas; doors could be kept closed and insulating barriers in extreme cases could be provided if necessary. This compact school freed the architect, engineer, and educational designer to focus all effort on a solution that could be determined solely by educational needs. The modern compact school was born in this atmosphere of freedom from old concepts and devotion to the human and educational needs of the present and the future.

Educators and taxpayers in all parts of the country began to examine this compact school, and they liked its freedom from orientation, its efficient plan, its controlled environment with good lighting and alert atmosphere. They particularly liked the fact that they could build it for up to 20% saving in first cost.

There was only one thing that bothered them about the compact school and that was the cost of operation. It did cost more to operate than the conventional school, and school boards are sensitive to anything that can be interpreted as wasting the taxpayers' money. Certainly a controlled environment to accelerate the rate of learning could not be considered wasteful. Nevertheless, a previous research study of a specific school of 2300 students with the same educational program, showed that the compact school, despite a savings in first cost, required $8,229 more per year to operate.

The thought was presented that if an electro-mechanical system could be found which would allow the compact school to operate for less money than the conventional school, then an ideal situation would exist. The result would be this—the compact school with its completely controlled environment could be built for up to 20% less first cost and could operate for less money than the conventional school.

This at first sounded like an impossible task, but there was a development born in the necessity of war and fostered by the demands of faster peacetime travel that immediately offered tremendous hope. This was the stationary version of the jet engine—the gas turbine. The aircraft industry has, through research and experience, proven the extreme reliability of the jet engine in military and commercial aircraft. The manufacturers of jet engines have adapted them for stationary applications such as aircraft engine starting, gas-compressor stations, and electrical power generation. These engines are known as gas turbines. The best fuel for the gas turbine is natural gas.

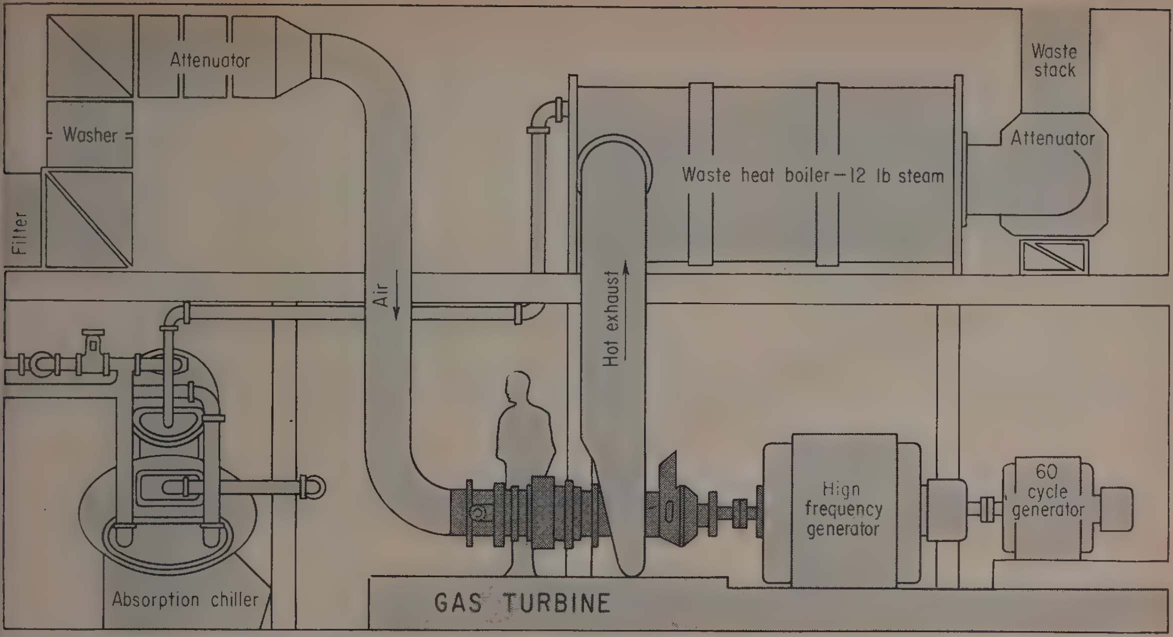
We traveled to gas turbine plants all over this country and Canada to find what turbines were available, in what sizes, and what auxiliary equipment could be obtained. We found gas turbines developed and in operation in sizes from 30 hp up to thousands of horsepower. We found turbine generator sets that would deliver 60-cycle power or 400-cycle power. We found that the airplane industry had standardized on 400-cycle power some years ago, and that this equipment could be obtained at good prices and free of development charges.

Power, Cooling, Heating

For the compact building, a gas turbine could be used to drive an electrical generator to provide for lighting, motors and convenience outlets. The exhaust heat from the turbine can be run through a waste heat boiler to make steam or hot water. The steam produced can be used to run an absorption air conditioning system, to heat domestic water for showers and kitchens, or for steam cookery. The waste heat boiler is used with the gas turbine because of the tremendous increase in thermal efficiency possible and the attending reduction in operating cost.

The gas turbine is a unique prime mover because of its reliability, ease of service, compactness, and its potentially lower first cost per horsepower. The gas turbine is much more compact than the diesel or reciprocating internal combustion engine and its rotating motion is continuous in the same direction as compared with the pistons which change direction with each stroke in the reciprocating engine. (Its continuous rotation in the same direction eliminates much of the wear associated with reciprocating machinery.) The gas turbine produces an even flow of sustained power. It has a minimum of working parts and very importantly does not depend on close tolerances for many of its components. It consists simply of a fuel chamber and a series of stationary and moving fins. The fins are attached to a rotary shaft from which the power take-off is direct. The simplicity of the turbine lends stability to its operation. It is dependable and very powerful for its size—and, of more importance, it is designed for thousands of hours of operation between maintenance overhauls.

The use of high frequency generators in this new system fascinated us because here was another place where we could do a better job for less money. We had provided high-frequency lighting for a very important client recently who wanted the finest lighting quality. At the same time, we saved considerable money in fixture cost and electrical distribution, but the cost of converting power from 60 cycle to 840 cycle was very high. Here, however, it was easy to reason that if we used gas turbines to generate



SOLUTION A shows a 700-hp gas turbine driving a 330-kw, 840-cycle, 480-volt generator and a 170-kw, 60-cycle, 120/208-volt generator, a waste heat boiler to generate 7650 pounds per hour of 12-psi steam, and a 368-ton absorption chiller driven by the 12-psi steam. Solution B would use a 900-hp gas turbine driving only a 600-kw, 480-volt, 60-cycle, 3-phase generator, with a waste heat boiler to generate 8320 pounds per hour of 12-psi steam, and a 400-ton absorption chiller driven by the 12-psi steam.

high-frequency power and if we would use standard equipment, we could obtain it at no premium in equipment cost and at considerable savings in energy cost. We decided we could generate high-frequency power for lighting the compact school and could parallel available packages to provide whatever amount of power was required and also provide a standby package at a nominal first cost. We decided to do the same thing for any 60-cycle power required for fan motors, pumps, convenience outlets, etc.

At this point, you are probably asking—Why high-frequency lighting? Here are some of the reasons. With high frequency lighting we have:

1. Higher lamp efficiency (more lumens per watt).

2. Standard lamps which may be burned at greater wattage.

3. Less lamps required to give the same quantity of illumination.

4. Reduced ballast heat loss to space.

5. Replacement of heavy ballasts with lightweight simple condensers.

6. Elimination of starters.

7. Reduction in the amount of air conditioning required in a given space for the same level of illumination.

8. Reduction in the total amount of power required for the building.

9. Reduction in first cost of lighting installation.

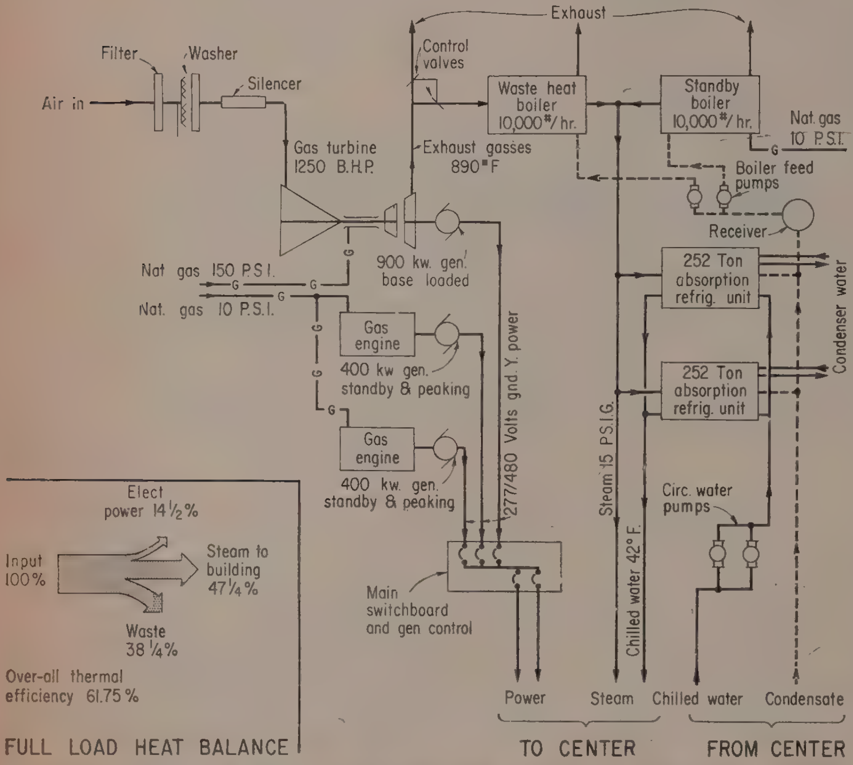
10. A much better quality of light.

It can be readily seen that unless we are using fluorescent high-frequency light that we are not taking full advantage of the principle of fluorescent light. We are requiring large bulky ballasts and fixtures, more tubes for the same amount of light; and we are not only paying more first cost, but more for the operating cost due to the lower efficiency, shorter lamp life, and increased heat added to the load of the air conditioned system. The other power requirements in a secondary school are mostly for 60-cycle motors, and small 120/208 convenience outlet power. By driving two generators from the same turbine, power for lighting can be generated at high frequency (e.g., 840 cps) and all other power at 60 cycles.

We still had two other problems facing us after making this decision to go to high-frequency lighting. We had to air condition the building and we had considerable amount of waste heat available from the exhaust of the gas turbines. (The gases leaving the turbine were in the neighborhood of 850°F.) We knew from the plants we had visited that waste heat boilers were already developed and were available. We decided to run the waste heat into such a boiler and to develop 12-pound steam to heat the building early in the morning, to heat water, and to operate an absorption chiller to provide cooling when required for that cycle of the air conditioning system.

There is an economic correlation in generating power for motors and lighting on the drive side of the turbine and generating steam for chilling water with the turbine exhaust gases. Each kilowatt of lighting supplied to the building in the form of lighting or motors adds 3414 Btu of heat to the air and requires a little over a quarter of a ton of refrigeration to remove this heat. The gas turbine then, while driving an electrical generator, pumps heat into the building in the form of electrical energy; but at the same time provides steam, by reclaiming heat from its exhaust gases, to make chilled water in an absorption machine which when circulated in a cooling coil will remove this same heat. This combination not only makes a very efficient package but one that is in thermal balance at all times.

Based on the foregoing, we tried all sorts of combinations of equipment to find a complementary mechanical and electrical system to go with the compact building that had provided such a desirable savings in first cost. The following solutions, which we shall call "A" and "B," met the basic requirement of allowing the compact air conditioned school to operate for less money than the non-air-conditioned conventional school.



ACTUAL INSTALLATION of a gas-turbine electromechanical plant is shown here in the power building of a large shopping center in Little Rock, Arkansas. At far left in photo is the 900-killowatt turbine generator that supplies electricity for the entire shopping center. Next (moving to right) come two conventional auxiliary generators, the boiler and two 252-ton absorption cooling units. The one-line flow diagram shows the integration of electrical and mechanical elements of the system, designed by Maury Hughes, of Leo L. Landauer and Associates, Engineers, Little Rock.

Solution "A" represents the best means of reducing operating costs in the compact school. As shown in an accompanying illustration, a gas turbine is driving a high-frequency generator to provide the lighting power and a 60-cycle generator to provide power for motors and convenience outlets. Actually the sketch is *symbolic;* and, in practice, several small turbines and generators are used, paralleling the high-frequency generators on one bus and the 60-cycle generators on another. Each turbine would have its own waste heat boiler. All steam supplies from the waste heat boilers would be run to a common header. If at anytime more steam were produced than required, the excess would be relieved to a condenser. The multiple unit practice has the advantage of lower first cost because of readily available packages priced lower because of larger production, and the fact that you have some diversity in the event of emergency service requirements.

Air for combustion is taken in from the outside, filtered, washed to reduce dry-bulb temperature and then passed through an attenuator to eliminate any inlet air noise. It then passes into the gas turbine where it is compressed to get a maximum amount of air into the turbine to provide air for combustion when mixed with natural gas under pressure. The combustion of this mixture assures a large amount of horsepower in a very small space and is a fundamental advantage of the gas turbine. The air compressor in the turbine and the driven generator are on a common shaft assuring very close control and regulation (regulation can be electronically controlled as closely as required).

Waste heat from the gas turbine passes through an insulated line to the waste heat boiler where it is converted to low-pressure steam. The exhaust gases then pass through an attenuator to further assure quiet operation and then are exhausted to the outside. The low pressure steam is passed through an absorption machine where chilled water is produced and circulated through cooling coils to remove the heat of the lighting system and human heat from the building. Early in the morning before the lighting and human heat

(Continued on page 116)

PAD-MOUNTED transformers outside an assembly building at Volkswagen reduce the 6000-volt primary supply to 220/380Y volts for utilization.

WORK IN PROGRESS on new power plant (left) will increase generating capacity for the works and the city of Wolfsburg.

Highlights of

Electrical Practice in West Germany

Notes and observations about current electrical installation practice from a visit to the modern city of Wolfsburg in West Germany and the manufacturing plants of Volkswagen.

By W. T. Stuart

WHAT are the most significant differences and similarities of foreign electrical construction and installation practices as compared with those in the U. S.? Some of these characteristics can be found in foreign industry journals. But first-hand observation can be even more meaningful and the opportunity of visiting major industrial installations in West Germany, even briefly and through a language barrier, proved highly interesting.

In late April, Volkswagen of America, distributors in the U. S. of the familiar small German automobile and its companion compact commercial vehicles, invited a group of business publication editors to inspect Volkswagen's modern manufacturing facilities in Wolfsburg and in Hannover. These notes were gathered on a 10,000-mile trip compressed into seven days on a rigorous time schedule.

Even from such a brief visit some general background observations are possible. West Germany is conspicuously prosperous. The scars of war have been largely obliterated. There is no unemployment. The tall steel cranes and scaffolding of new construction are seen everywhere. Building craftsmen are scarce and command relatively high wages.

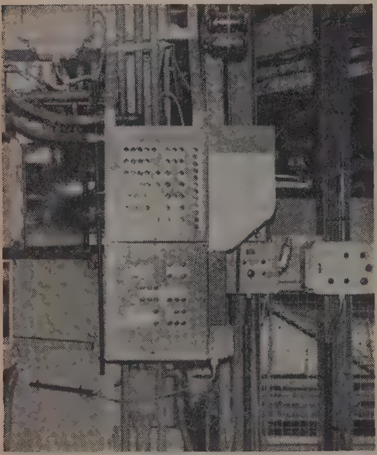
Electrical crafsmanship is notably good. While methods and standards are often different from U. S. practice, equipment and installations are sturdy, neat and well maintained.

Industry procedures are essentially similar to ours. Buildings are planned by architects. Electrical systems are designed by consulting engineers and installed by specialty electrical contractors usually licensed in their communities. A national code, called the VDE, is written and sponsored by the Federation of General Electro-Technicians. Large industrial plants have electrical departments for routine in-plant changes, alterations and maintenance.

Fluorescent lighting is used almost universally for general illumination. Levels appear somewhat lower than American practice, but a good deal of supplementary lighting is applied for inspection and other critical seeing tasks.

PUMP MOTORS circulate high-pressure hot water for space heating in the city. Units shown are each 125 kw, 1460 rpm, 85% pf, 380-volt, 3-phase, 50-cycle.

CONTROL CENTER on a large automatic press. Cabinets are accessible only to authorized personnel.



WIRING DETAILS around a control panel, at extreme right, is a typical installation of small sheathed cables on cleats.

HIGH-CYCLE TOOLS are suspended from 3-phase trolley systems energized at 170 volts, 200 cycles from a rotary frequency converter.

WELDING CONTROL, the cast fitting below is a typical fused disconnect switch rated at 250 amps, 600 volts.

Utilization voltage is 220/380Y, 3-phase, 50 cycles, with grounded neutral. In large plants, distribution is often 6000 volts delta with load-center transformations in vaults under the manufacturing area or on pads outside of the building. Large motors may be operated directly on the 6000-volt supply.

Motors

Motor speeds reflect the 50-cycle power frequency with synchronous speeds of 3000 or 1500 rpm. Motors are rated in kilowatts rather than horsepower. Nameplates also show voltage, full-load current, speed, power-factor ratings and type.

Exposed wiring below 5 ft above the floor was installed in conduit. Enclosures for fused cutouts, disconnect switches or junctions were heavy cast boxes. Above 5 ft exposed wiring was non-metallic sheathed cable supported on small insulating cleats spaced about 10 in. (possibly 20 cm) apart. The workmanship on these cable runs was invariably precise and neat.

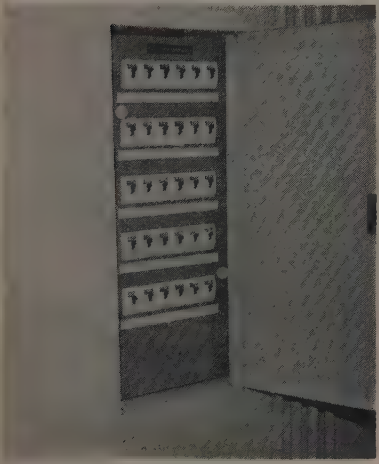
There is no exact counterpart to this type of wiring in general use in the U. S. The construction consists of plastic insulated conductors in an aluminum sheath with an over-all plastic coating. It is semi-rigid but readily bent and formed during installation like our MI cable.

Wiring around machines was installed in rigid conduit with oil-tight flex connections to motors. In some areas control wiring was distributed overhead in enclosed sheet-metal wireways, which appeared to be similar to our 4 by 4.

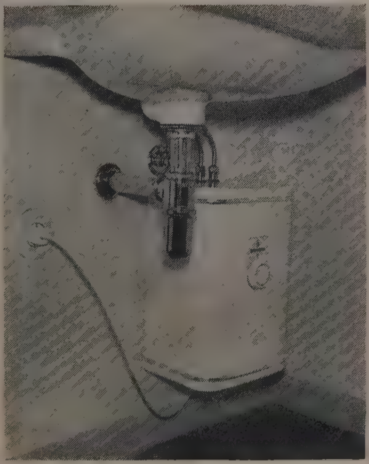
Hi-cycle assembly-line power tools were suspended from trolley-duct supplied with 170-volt, 3-phase, 200-cycle power.

In the Volkswagen plants, automatic spray painting is applied with the most modern American electrostatic equipment. Drying

OPERATING SWITCHBOARD for an electric baking tunnel, part of the body painting and finishing process, which includes automatic electrostatic spray painting.



BRANCH-CIRCUIT distribution panel in a commercial installation with 24 10-amp and six 20-amp circuit breakers.



ELECTRIC WATER HEATER serving a lavatory sink. The unit is plugged into a 20-amp branch circuit receptacle.

tunnels are all-electric. Automatic electric welding machines appear to be pretty much in line with the most advanced Detroit practice.

The two plants visited are extensively automated with elaborate automatic and program-control apparatus. In many instances, the control gear is mounted on small catwalk mezzanines built above the machinery. Power feeders are brought up through the floor. No overhead power distribution was apparent in the manufacturing areas.

General lighting is provided by continuous-row 2-lamp fluorescents in open reflectors mounted on the ceiling. The reflectors are polished aluminum.

The Wolfsburg plant is supplied from its own generating facility, which also supplies the city of Wolfsburg. Eight 3000-rpm steam-turbine generators sets are currently in operation, and a new power plant is under construction. Electricity is generated at 6000 volts. For a part of the city distribution, it is stepped up to 15,000 volts.

The city of Wolfsburg is spectacularly modern. Most of it has been built in the past 15 years, paralleling the growth of the Volkswagen plant, which is its only major industry. The entire city is heated by a hot-water supply system from the plant operating at 225 lb per sq in. The water temperature is varied with the weather.

Another striking and most attractive feature of this city is the absence of pole lines. All electric power and phone lines are installed underground. Power cables are direct burial, polyethylene insulated with corrugated-aluminum plastic-coated armor. Telephone and other low-voltage services are installed in ducts.

Street lighting is modern, mostly fluorescent, and operates on constant-voltage circuits with central photo-cell control. The fixtures are 2-lamp types on two circuits. One lamp is switched off from 11 pm to 5 am. Lamps are replaced on a group-replacement schedule and outage reports.

Wiring devices are notably different from products used in the U. S. except in function. Switch and receptacle plates are circular, about 3 in. in diameter. Switches have, typically, a small rocker-type operating handle. Relay switches have a single round center button, and the relays operate sequentially on and off. Receptacles take relatively large attachment plugs with cylindrical prongs and are often recessed. The utilization voltage is 220 and general-purpose branch circuits are protected with 10-amp fuses or circuit breakers.

Appliances

Electric water heaters are widely used but the appliances are quite different from those used in the U. S. The tanks are small and connected directly to the plumbing fixture supplied. They are not under water pressure. The hot water outlet is open to the fixture. Hot water is drawn by opening a valve which brings cold water into the heater at the bottom and forces the hot water out at the top. Water heaters are typically 3 kw in capacity and served by a 20-amp branch circuit.

Electrical appliances for the home are abundant and popular. They tend to be smaller in size than U. S. models. Television, radio, and stereo music systems are highly popular. Notably absent were clothes dryers and air conditioners, although these are said to be available.

Use Today's
Industrial Lighting Tools
Intelligently

By Theodore Ake, *IES,*
Application Engineer, The Miller Company, Meriden, Conn.

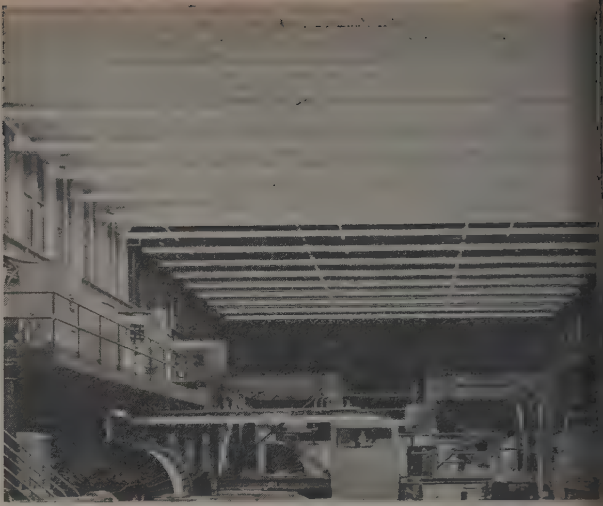


FIG. 1—Effect of relighting and repainting is dramatically demonstrated in this high bay area. In the far background is an inadequate, out-dated lighting system. A new lighting system has been installed in the central area, but it has not been repainted. The foreground area has been both relighted and repainted. The luminaires in this area blend in with the light-colored ceiling and side walls, providing a substantial increase in the lighting level and in visual comfort.

In the selection and design of lighting systems for industrial lighting applications, many factors influence over-all lighting costs and lighting quality. These factors, and their many inter-related effects, are herein described and discussed.

THE rapid acceptance of the new recommended levels of illumination, particularly in the area of 100 footcandles, and the many recent improvements in the three major light sources—fluorescent, mercury, and incandescent—have given rise to frequent questions pertaining to the best system for a particular area from the standpoint of economics, visual comfort, and reflected glare.

Economics

There are eight factors which determine the cost of any lighting system. These factors are shown in Table I.

The first four factors in Table I are fixed by the area to be lighted. The last four factors, however, are variable and should be studied carefully to determine their effects on the economics of the system.

This can be done only by preparing a cost analysis which includes all of the factors affecting the total annual cost of light. Such an analysis can be prepared easily by following a simple system suggested by A. C. Barr and C. L. Amick ("Fundamentals of Lighting Cost Analysis," *Illuminating Engineering*, May 1952), which includes the amortized cost of equipment and installation, cost of maintenance including cleaning and relamping, and electrical energy.

Too frequently, initial cost alone is the determining factor in purchasing a lighting system. The utilizations of various possible choices should first be compared, since a luminaire which provides more light can obviously cost proportionately more. Similar comparisons should be made of the ease of installation and maintenance because, once purchased and installed, the system must be operated and maintained over an extended period of time. Frequently, an extra dollar spent at the beginning can be returned many times over during the life of the system.

Table II shows the relative annual cost of light for each of three light sources, distributed among the major categories. A breakdown of this sort must, of course, be of a general nature and will vary from job to job, depending on mounting height, labor rates, reflectances, etc.

Table II provides a quick means of visualizing where lighting dollars are actually spent and thus helps to avoid the trap of false economy. The initial cost of the equipment, amortized over ten years, is at worst no more than 20% of the total annual cost, and in every case the cost of installing the system is greater than the equipment cost. (Installation includes all labor and materials from the panelboard which controls the lamps, up to and including the luminaires.) The time required to simply hang a luminaire varies greatly from unit to unit. Up to 45 minutes per unit can be saved by selecting a luminaire which can

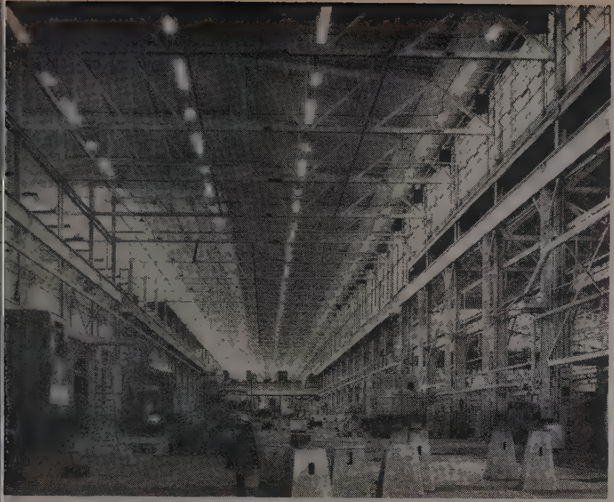


FIG. 2—Typical heavy-industrial area shown here is lighted by a combination fluorescent-mercury lighting system. The 1500-ma fluorescent units provide about one-third of the total illumination, and 400-watt color-improved reflector mercury lamp units provide the remaining two-thirds. The fluorescent system replaced the original incandescent lamp reflector units and resulted in increased illumination and greatly reduced costs.

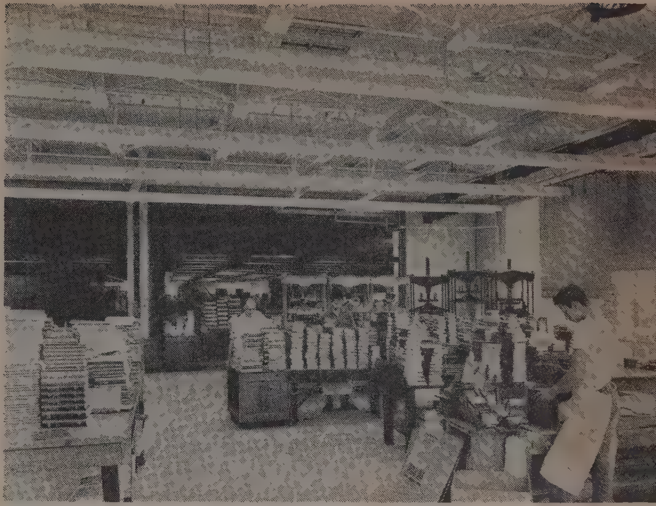


FIG. 3—Low-bay area in foreground of this light-industrial plant has been completely light-conditioned. Continuous row fluorescent reflector units provide a high level of completely diffused and uniform illumination and some upward light which reduces the brightness contrast between the lighted reflector surfaces and the ceiling above. The background area, despite its being lighted to a level of 50 footcandles, seems dingy by comparison.

be quickly installed. With today's high labor costs, these 45 minutes represent possible savings of well over $4 per unit which should be subtracted from the purchase price before deciding which unit is actually lowest in initial cost.

Another area where economics are frequently misapplied is in maintenance. The labor for relamping and cleaning ranges from only 6% to 11% of the annual lighting budget, yet maintenance is one of the major variable factors affecting the cost of light. One extra cleaning per year may cost $1.75 or $2.00 per 8-ft fluorescent unit, but the extra cleaning provides a higher maintained footcandle level, and can actually reduce the number of luminaires required for a given level of illumination by as much as 7%. This, in turn, would reduce the entire cost by the same amount.

Before a cost analysis can be prepared, a simple layout must be prepared, since rarely does the number of units calculated for a given footcandle level provide a symmetrical arrangement.

Low Bay Areas

Chart I shows an area lighted to approximately 100 footcandles with three different types of fluorescent lamps. Based on high reflectances and good maintenance, Layout I actually provides 102 footcandles; Layout II, 108 footcandles. Layout III provides 108 footcandles based on the use of porcelain enamel units, but only 97 footcandles with a more comfortable, low brightness Alzak aluminum reflector. Therefore, to fairly evaluate the systems, the costs should be compared on a "per-footcandle basis."

In Layout III, the units are mounted individually, rather than in continuous rows, which increases installation cost considerably. This layout also indicates that at some lower footcandle level the 1500-ma lamp could not be used, regardless of the economics, since the spacing limitations would be greatly exceeded, resulting in very spotty illumination.

Chart II is a comparison of the systems shown in Chart I. The spread from the most expensive

TABLE I—Factors Which Determine Lighting System Costs

1. Room size and shape
2. Electric power rate (cost per kwhr)
3. Hours of operation (per unit of time)
4. Labor rate (for installation)
5. Reflectances (of interior surfaces)
6. Maintenance procedures
7. Relamping practice
8. Distribution voltage

Table II—Relative Annual Cost of Various Light Sources

	Incandescent	Mercury	Fluorescent
Amortized Investment			
Equipment	2%	14%	20%
Installation	18%	27%	27%
Maintenance			
Lamp	15%	19%	11%
Labor	6%	2%	11%
Energy*	59%	38%	31%
	100%	100%	100%

* Based on 2 shifts and $0.01 per kwhr.

Chart I—Lighting Layouts to Provide 100 Footcandles

LOW BAY AREA

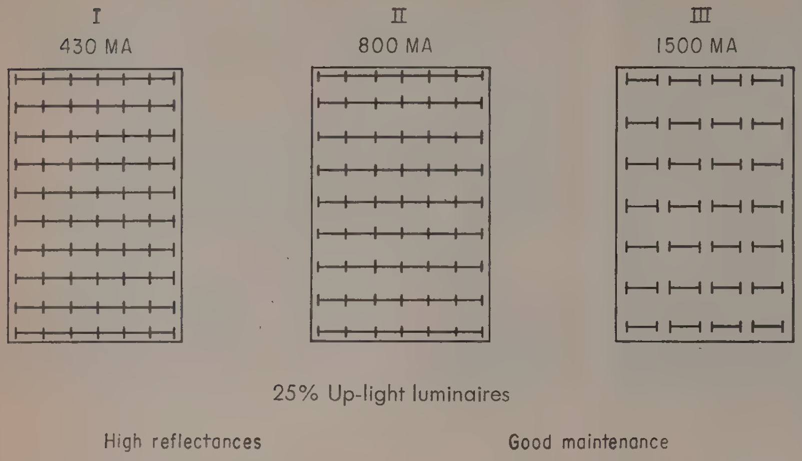
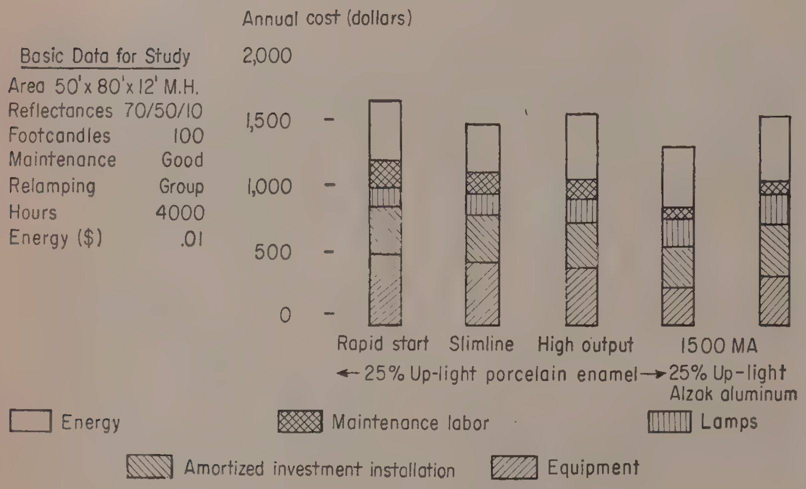


Chart II—Cost Comparisons of Various Fluorescent Lighting Systems

LOW BAY AREA



rapid-start to the most economical 1500-ma system is only 19%, which represents about 8 cents per sq ft per year. The much more comfortable Alzak aluminum system costs only five cents more per sq ft than porcelain enamel.

High Bay Areas

The problem of selecting the best lamp-fixture combination in high bay areas is more complex. Instead of dealing only with fluorescent, both incandescent and mercury must now be considered. Mercury lamps may be either clear or color-improved, and both mercury and incandescent are available in standard and reflector styles. To add to the confusion, reflectors for light sources are available of porcelain enamel, aluminum, or prismatic glass, all with a wide variety of light distributions.

The apparent number of possible mercury and incandescent lamp-reflector combinations can be quickly reduced by again referring to Table II. The equipment for a typical mercury system amounts to only 14% of the total annual cost, of which the ballast accounts for over half. Thus the mercury reflector actually represents only about 6% of the total cost of light. Similarly, incandescent reflectors represent only about 2%.

Since all costs are proportional to the number of units required, it follows that the most efficient lamp-reflector combination will be the most economical.

For example, consider an area 100 ft by 120 ft with a 40-ft mounting height lighted to 100 footcandles with 400-watt white mercury lamps. Aluminum reflectors cost over 80% more than porcelain-enamel; however, in this case, the aluminum is 15% more efficient. While the 80% may appear significant, it actually affects only the very insignificant 6% of the total cost of light represented by the reflector; while the 15% higher efficiency of the aluminum directly affects all of the other factors represented by 94% of cost of light. In this example, every extra dollar invested in the aluminum reflector saved $8.83 over the amortized life of the system.

Chart III compares all three sources in their most efficient reflectors in the typical high bay area. Twin reflector units were used with the incandescent and mercury lamps to reduce the installation and maintenance costs and to take advantage of the economy of 2-lamp ballasts where they are available.

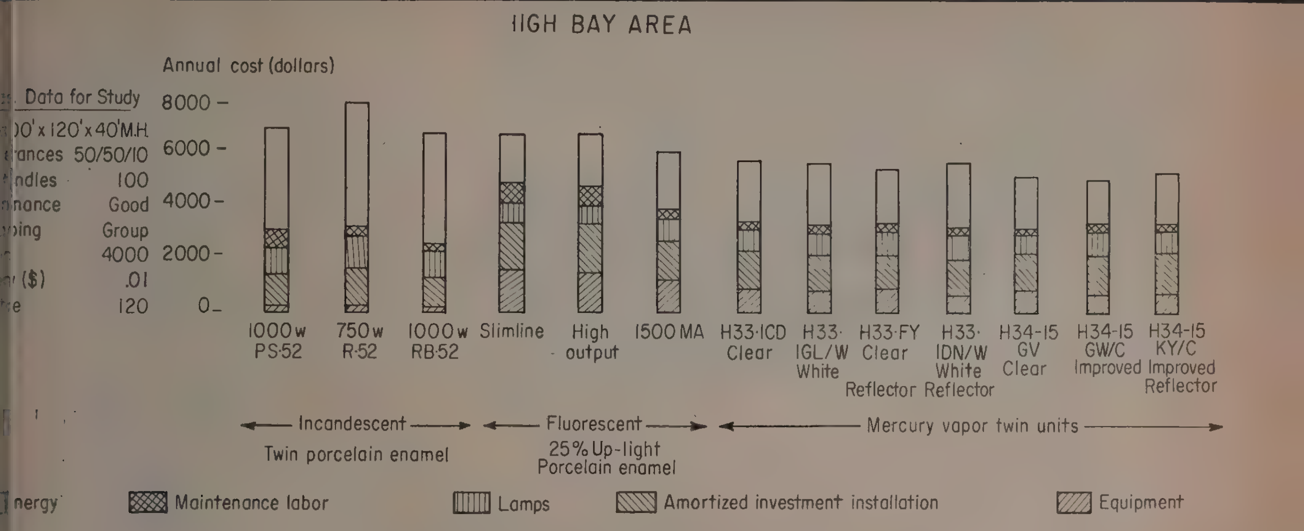
In this particular case, the mercury lamps are the lowest in total cost, with the 1000-watt being slightly more economical than the 400-watt. It should also be noted that the low efficiency and short life make the incandescent lamp the least economical of the three types of lamps, despite the very low initial equipment cost.

Comparisons of this sort are valid only for a specific set of conditions. In this case, there is a maximum variation of only 11% between the lowest cost, 1000-watt white mercury and the highest cost, 400-watt clear mercury (1500-ma fluorescent also falls within this range). This emphasizes the fact that any major deviation from the specified conditions will require another analysis.

Lighting Maintenance

Good maintenance procedures make possible savings in the annual cost of light of from 20% to 25% with incandescent and mercury, and of up to 30% with fluorescent systems.

Chart III—Cost Comparisons of Various Lighting Systems



The footcandle level of a lighting system begins to decrease almost from the moment that it is installed. The lumen output of the lamp decreases over the rated life. Dirt collects on lamps and reflectors as well as on room surfaces. The lighting designer attempts to compensate for this drop-off by including a maintenance factor in his calculations. The maintained footcandle level is the lowest value to which the system is permitted to fall before maintenance procedures are instituted. This factor varies with lamps, luminaires, environment, and anticipated maintenance procedures.

While there are some areas such as coal mines, mold shake-out areas, etc., where the very rapid collection of dirt is inevitable, in most cases suitable maintenance procedures will prove to be a profitable investment as shown by Chart IV. Both columns represent the cost of providing 100 maintained footcandles in the low bay area described in Chart II, the difference being in the reflectances and maintenance procedures. The "good" (lefthand) column is the 1500-ma lamp in the porcelain-enameled reflector shown in Chart II. It is assumed that lamps and reflectors are cleaned twice a year.

To achieve the same 100-footcandle level with low reflectances and poor maintenance (cleaning only when relamping), requires 43 luminaires instead of 26. This, of course, raises the cost of equipment, installation, and energy in proportion; however, it is frequently assumed that these increases are offset by the saving in maintenance. As shown by the "poor" (righthand) column, the exact opposite is true. Due to the increased number of lamps required and the higher per-lamp cost of spot relamping, the total cost of maintenance is actually higher than in the well-maintained system.

Similar savings can be shown for high bay areas even though maintenance is generally more costly than where ceilings are lower. Relamping and cleaning must usually be done from a crane or movable scaffolding, making spot-cleaning and relamping very costly. Ceilings are frequently of the open truss type with low reflectances. Since periodic painting is necessary to prevent deterioration, it might as well be a light color which not only slightly increases the efficiency of the system but adds greatly to seeing comfort.

Walls are easier to paint and keep clean than ceilings, and are more important to the economy and comfort of the system. Increasing wall reflectances from 10% to 50% reduces the cost of a mercury system about 9%, and a fluorescent system about 15%—in addition to a very noticeable increase in visual comfort.

The use of ventilated lighting equipment has been generally accepted as an excellent means of reducing dirt collection on lamps and reflectors. At first, this ventilation was kept to a minimum to prevent "losing too much light" toward the ceiling. The upward lighting component was not "lost" since most of it would have been trapped within the luminaire and at least a small portion is reflected downward from the ceiling. As lamp output ratings increased, the need for reducing the brightness difference between the brighter luminaire and darker ceilings became increasingly evident. Today, the use of 20%-30% up-light is recommended in almost all production areas. In the case of 1500-ma lamps, this much up-light and ventilation is almost essential to prevent reduced lamp-light output due to operating above the optimum bulb-wall temperature.

In spite of improvements in color and life, the mercury lamp still has the distinct disadvantage of slow restarting after a power failure or voltage dip. To provide some lighting for safety, designers have recommended that about 20% of required footcandles be provided by incandescent lamps. Such a system is generally uneconomical due to the low efficiency, short life, and distribution voltage limitations of the incandescent lamp. Since both mercury and fluorescent can use higher distribution voltages and have approximately the same life, they are now being used very economically together to achieve the same degree of safety.

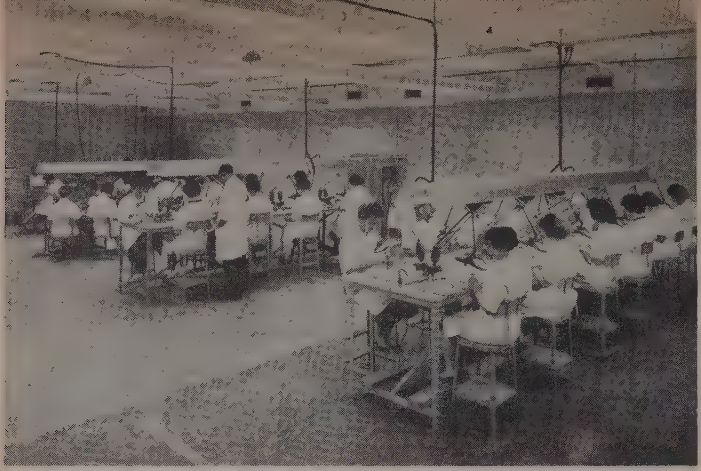


FIG. 4—Seeing tasks in this plant are classed as "very difficult," and require freedom from direct glare, as well as high footcandle levels. Low-brightness aluminum reflectors, designed to effectively control the direct glare and the light of the new high-output lamps, were used to light this area.

Distribution Voltages

Higher distribution voltages generally result in substantial savings both in wiring costs and in ballast weight. Chart V is a comparison of the lowest cost fluorescent, 400-watt and 1000-watt mercury systems on 120-, 277-, and 480-volt distribution systems. The fluorescent and 400-watt mercury systems show a saving of approximately 7% as the voltage is increased from 120 to 480 volts. Due to the greatly reduced price of ballast equipment, the 1000-watt mercury system at 480 volts is approximately 20% lower in cost than the same system at 120 volts.

Visual Comfort

While economics and footcandle levels are of great importance, they should not be the only criteria used for selecting a lighting system. Of at least equal importance is the quality or comfort which is provided.

It is always wise to plan for the future, particularly when considering visual comfort. Every source which has been invented has been improved upon and with each improvement producing more light. This higher light output, however, also means increased brightness. Luminaires should, therefore, be chosen to provide adequate brightness control not just for today's sources but for the higher brightness light sources of the future.

Comfort is frequently difficult to visualize in industrial areas due to the wide variety of tasks, working conditions, etc; however, many progressive managements now realize that profits are made in the factory—not in the office—and are beginning to provide lighting systems in the plant comparable to those in the office.

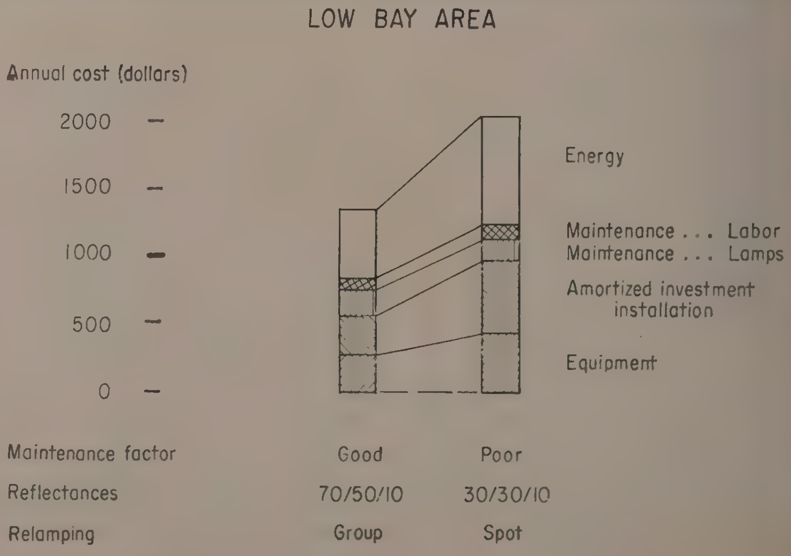
Shown in Fig. 3 is a system using 1500-ma lamps, in 25% up-light porcelain enamel units, with 24° crosswise shielding. These units provide approximately 160 footcandles on the tasks from a 14-ft mounting height. For this particular task the higher brightness of porcelain enamel may be satisfactory, since all the workers are oriented so as to take advantage of the crosswise shielding. The entire visual environment has been made light so as to reduce contrast and increase efficiency. Blinds have been provided to control the glare produced by outside daylight. All room surfaces have been finished in light colors for maximum lighting efficiency and visual comfort.

The contrast between the relighted area in the foreground and the older system in the rear is typical of the changes taking place throughout industry. It is significant that the very dark, dingy-appearing rear area is lighted to 50 footcandles, which is nearly double the average industrial lighting level prevailing throughout the United States today.

Where seeing tasks are more difficult, as in the area shown in Fig. 4, even higher levels and greater comfort are required. The overhead system provides over 200 footcandles from aluminum reflectors designed to provide 35° crosswise shielding and to control the brightness of the new higher-output lamps. In certain of the most critical areas, the same unit is mounted directly over the work table and provides a total of 600 footcandles on the task.

The use of low brightness aluminum reflectors is excellent for controlling direct glare; however, the problem of reflected glare is not so easily solved. Reflected glare results from a source being reflected from a specular surface into the observer's eye, which reduces the contrast of the visual task. Recent studies have shown that many surfaces, such as pencil writing, previously thought to be

Chart IV—Effect of Maintenance and Reflectances on Cost of Light



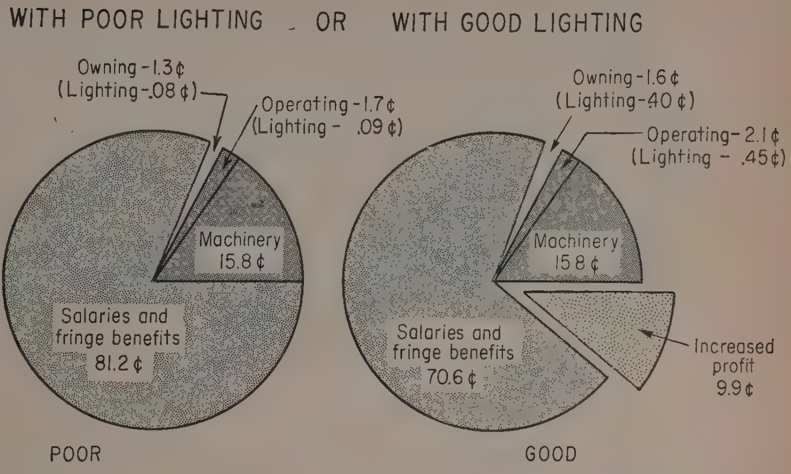
matte, are actually highly specular.

For many years it was believed that reflected glare could be eliminated only by reducing the source brightness or changing the observer's position. The demand for higher lighting levels necessitates higher rather than lower brightness sources, and often the observer's position can not be moved to reduce glare.

Recent research indicates that other means of controlling reflected glare may be practical. One suggested method is to increase the number of sources. In any problem of reflected glare, only one source is generally so situated as to be reflected into the observer's eye. As additional sources are added, the percent of the total illumination on the task from the offending source is reduced and the illumination from the non-offending sources increases the contrast of the task and thereby increases visibility.

Another suggested system involves raising the footcandle level without changing the geometry of the system. The work of Dr. Richard Blackwell and the recommended footcandle levels derived from it are based on a glare-free environment. The presence of glare reduces the contrast between the task and the background, which decreases the visibility of the task. By increasing the footcandle level sufficiently, the visibility under the glare-present condition can be increased back up to that of the glare-free situation. For instance, for tasks requiring levels near 50 footcandles, a 15% loss in contrast can be overcome by increasing the footcandle level approximately three times. This could be accomplished by replacing 430-ma with 1500-ma equipment.

Chart VI—How Industry's Dollar Can Be Spent



Knowing the most economical or comfortable lighting system is not really important to the end user unless he is convinced that the benefits which he can derive from the new system will justify the investment. The plant owner is not buying light; he is buying results.

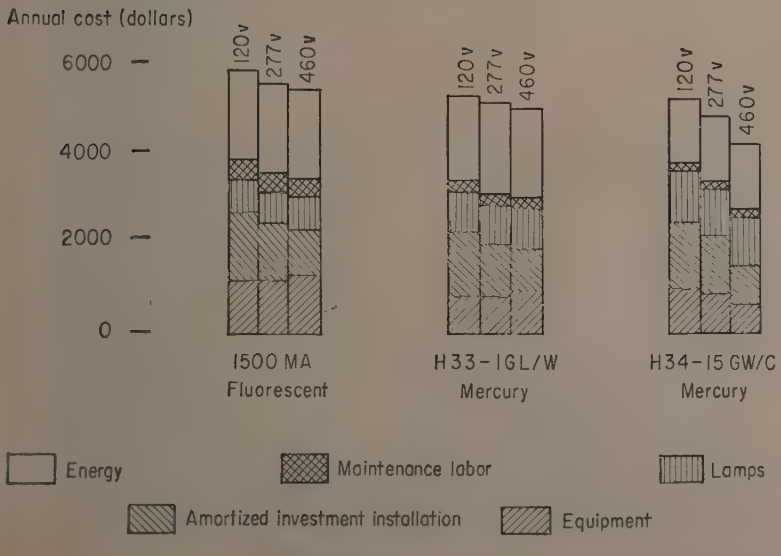
The results of surveys of many industrial areas of all types indicate that proper illumination can typically increase production 13%, reduce rejects 33%, and decrease accidents 45%. While not all of these benefits may be present on every job, it can easily be shown that even a part of any one benefit will certainly more than justify the cost of good lighting.

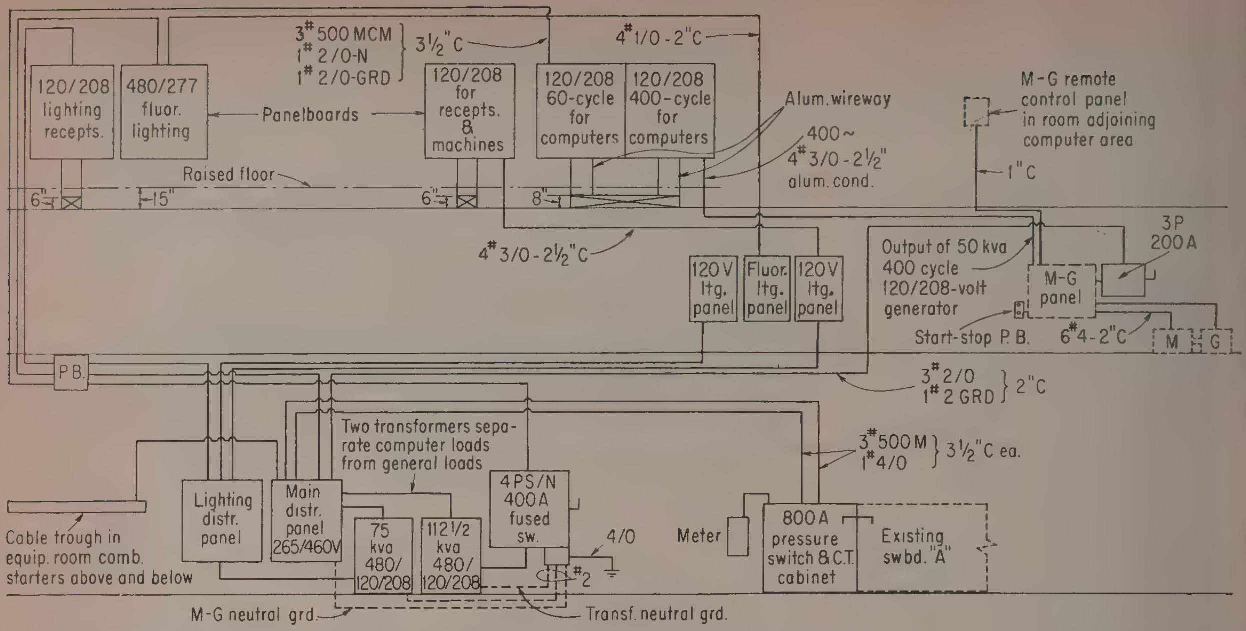
Assuming a 10,000-sq-ft low-bay area, the 1500-ma lamp in the comfortable aluminum reflector will provide 100 footcandles for only 96 cents per hour. The same lamp in a porcelain-enameled reflector mounted at 40 ft and operating at 480 volts will provide the 100 footcandles for only $1.12 per hour.

These costs amount to only 1½% of the cost of production, which means simply that if the new lighting system can save seven minutes per working day, it is paying its own way.

Chart VI shows how a typical industry can spend its cost dollar. Every industry requires some light, the cost of which is included in the tiny owning and operating segments of the "poor" chart. A modern comfortable lighting system with recommended footcandle levels may cost five times as much as the inadequate system, as shown in the "good" chart. This represents only eight tenths of a cent. Whereas if the modern lighting increases production, the 13% mentioned previously, the return on the investment—shown as "increased profit"—is 9.9 cents. This is the type of investment that is sought by everyone.

Chart V—Distribution Voltage vs Cost of Light





RISER DIAGRAM shows basic distribution for the National Cash Register space on three floors of a new office building. Distribution includes 480/277-volt circuits and 120/208-volt circuits—60 cycle and 400 cycle.

Wireway Circuits Power Computers

Here's how the engineering skill and imagination of Frank Aluisio, chief electrical engineer of Air Research Associates, consulting engineers, combined with the construction know-how of John Compton and the crew of Arc Electrical Construction Company to meet the challenge of another New York City data processing center.

By J. F. McPartland

WIREWAY circuits in a floating floor represent the unusual connecting link between a compact distribution system and the computer machines at National Cash Register's new data processing center, New York City. Here, both 60-cycle and 400-cycle power at two voltage levels is delivered to the machines by special receptacle outlet circuits in the wireway. Many novel and interesting factors are involved in the electrification of this data center.

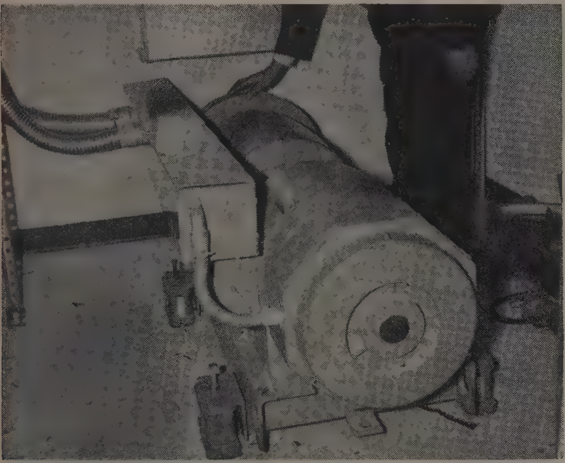
Complete layout and design of the center was made by the Data Center Design Division of Air Research Associates, consulting engineers who were retained by National Cash Register. Air Research obtained the space, planned and designed the interior, and provided all mechanical and electrical engineering design.

The center occupies a total floor space of 16,000 sq ft divided between the ground floor and the lower level in a new, modern office building. The computers are arranged in a richly-decorated, extremely well lighted area on the ground floor. Other ground floor space is used for reception area, conference rooms and executive offices. The space in the lower level contains various administrative and clerical offices. In addition, a small room in the second basement houses the distribution equipment for the center and is fed from the metered main switch in the adjacent main switchboard room of the building.

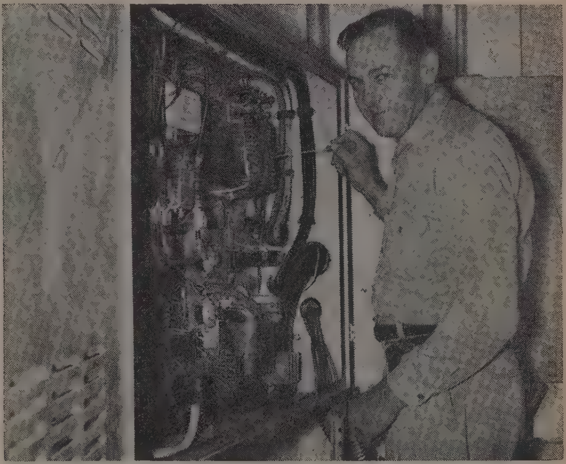
Based on known and expected power and lighting loads plus a substantial measure of spare capacity, the main switch for the data center was sized at 800 amps.

MAIN SWITCH ENCLOSURE is connected to the end of the main building switchboard from which it is fed. Top section contains CTs for metering; bottom section contains 800-amp, fused pressure switch. Two circuits from top carry multiple-conductor main feeder to nearby distribution room.

DISTRIBUTION CENTER for the complete system is a small room in the sub-basement, containing a main circuit breaker panelboard (left), which is fed from the 800-amp main switch, and two transformers stepping 480-volt, 3-phase power to 120/208-volt level for 3-phase, 4-wire circuits to lighting and receptacle loads. Transformer at right background is a 112½-kva unit supplying the computer circuits in wireway on the first floor and isolating these loads from other 120-volt circuits. The other transformer, rated 75 kva, is used to supply general purpose 120-volt loads.



MOTOR-GENERATOR SET in small room in first basement provides 50-kva of 400-cycle, 120/208-volt output required for computer machines in the data processing area on the floor above. Note the use of vibration isolators which form a cradle to support the four legs of the M-G platform. These rubber isolators are not anchored to the floor; they simply rest on the floor surface. Noise output of this machine is effectively minimized, preventing vibrations in the floor.



PART-WINDING STARTER for controlling the 75-hp motor drive of the M-G set was installed in the M-G room by Tom Amlin, Arc Electrical Construction Co., a specialist in wiring of complex control circuits.

This is a bolted pressure switch in a floor-standing enclosure attached to the main building switchboard, with metering current-transformers in the switch enclosure.

Short-circuit and overload protection is provided for the 480/277-volt, 3-phase, 4-wire feeder by three 800-amp fuses of high interrupting capacity. These fuses can readily clear any value of short-circuit fault produced in the circuit and have time-current characteristics to coordinate selectively with the operating speed of the circuit breakers in the power panel on their load side. From this switch a main feeder—three 500 MCM and one No. 4/0 in each of two 3½-in. conduits—is run to a power panel of molded-case CBs in a nearby distribution room in the sub-basement.

In the small distribution room, the basic distribution elements are neatly grouped along one wall. These consist of: the main distribution panel fed from the main switch; a 480-120/208-volt transformer rated at 75 kva, feeding a nearby panel for general lighting and receptacles on the two floors; and a similar transformer, rated at 112½ kva, to supply only the computer machines in the computer room. It is interesting to note that the total load of 120/208-volt demand was divided between two transformers instead of being served from one transformer. This arrangement permitted separation of all computer loads on their own transformer, isolating these loads from any faults or outages in the general purpose 120/208-volt circuiting. Riser diagram shows layout of distribution equipment for the National space.

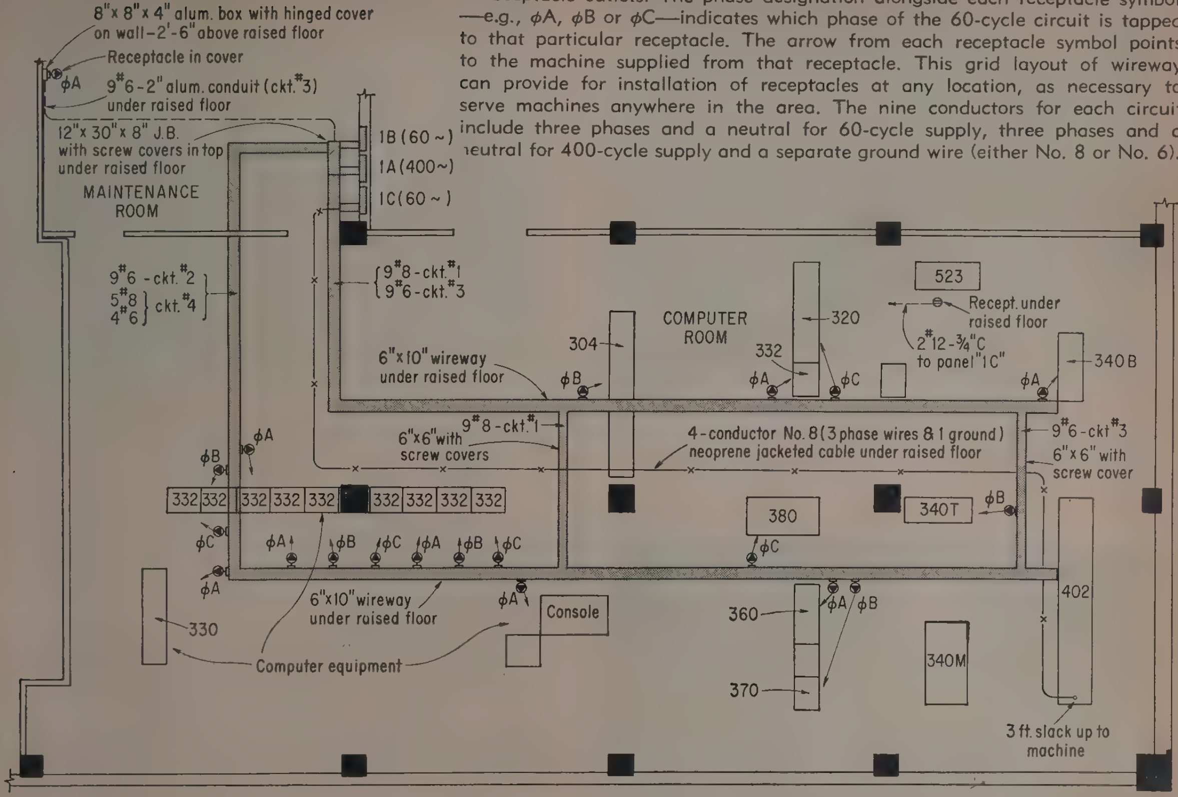
PANEL SCHEDULES

60 CYCLES—PANEL "B"									400 CYCLES—PANEL "A"								
Circuit No.	Circuit Breaker			Machine No.	60~ Kva	60~ Amps Per φ			400~ Kva	400~ Amps Per φ			Machine No.	Circuit Breaker			Circuit No.
	Frame	Poles	Trip			φA	φB	φC		φA	φB	φC		Frame	Poles	Trip	
1.	100A	3	50A	Console	0.6	5.0	....	....	0.5	1.4	1.4	1.4	Console	100A	3	50A	1.
				304	0.5	....	4.2	....	6.9	19.0	19.0	19.0	304				
4/8				Future	0.5	....	....	4.2	0.5	1.4	1.4	1.4	Future				4/8
RHW				Total	1.6	5.0	4.2	4.2	7.9	21.8	21.8	21.8					RHW
2.	100A	3	70A	332	1.3	11.0	....	....	0.3	0.9	0.9	0.9	332	100A	3	70A	2.
				332	1.3	....	11.0	....	0.3	0.9	0.9	0.9	332				
4/6				332	1.3	....	....	11.0	0.3	0.9	0.9	0.9	332				4/6
RHW				332	1.3	11.0	....	....	0.3	0.9	0.9	0.9	332				RHW
				332	1.3	....	11.0	....	0.3	0.9	0.9	0.9	332				
				332	1.3	....	....	11.0	0.3	0.9	0.9	0.9	332				
				332	1.3	11.0	....	....	0.3	0.9	0.9	0.9	332				
				332	1.3	....	11.0	....	0.3	0.9	0.9	0.9	332				
				332	1.3	....	....	11.0	0.3	0.9	0.9	0.9	332				
				330	0.3	2.8	....	....	3.9	10.8	10.8	10.8	330				
				Future	0.3	....	2.8	....	3.9	10.8	10.8	10.8	Future				
				"	1.3	11.0			0.3	0.9	0.9	0.9	"				
				"	1.3	....	11.0	....	0.3	0.9	0.9	0.9	"				
				"	1.3	....	....	11.0	0.3	0.9	0.9	0.9	"				
				Total	16.2	46.8	46.8	44.0	11.4	32.4	32.4	32.4					
3.	100A	3	70A	340B	0.2	1.7	....	....	3.9	10.8	10.8	10.8	340B	100A	3	70A	3.
				340T	5.8	....	48.0	....	0.4	1.1	1.1	1.1	340T				
4/6				320	0.3	....	....	2.5	4.4	12.2	12.2	12.2	320				4/6
RHW				332	1.3	11.0	....	....	0.3	0.9	0.9	0.9	332				RHW
				Maint. Rm.	2.0	16.7	....	....	1.0	2.8	2.8	2.8	Maint. Rm.				
				Future	0.2	1.7	....	....	3.9	10.8	10.8	10.8	Future				
				"	5.8	....	....	48.0	0.4	1.1	1.1	1.1	"				
				"	0.1	....	0.9	....	2.1	5.9	5.9	5.9	"				
				"	1.3	11.0	....	....	0.3	0.9	0.9	0.9	"				
				Total	17.0	42.1	48.9	50.5	16.7	46.5	46.5	46.5					
4.	100A	3	70A	360	2.5	21.0	....	....	1.0	2.8	2.8	2.8	360	100A	3	50A	4.
				370	1.3	....	11.0	....	0.7	1.9	1.9	1.9	370				
4/6				380	5.0	....	....	42.0	1.0	2.8	2.8	2.8	380				4/8
RHW				Future	1.3	....	11.0	....	1.0	2.8	2.8	2.8	Future				RHW
				Total	10.1	21.0	22.0	42.0	3.7	10.3	10.3	10.3					

CIRCUITS AND LOADS for the two panels feeding circuits in wireway to the 9-pole receptacles for the individual machines. Note that each machine is fed by a separate receptacle (as shown on accompanying floor plan of computer area). There is a receptacle for each entry listed under the heading "Machine No." Note that each machine takes so much current from one phase of the 60-cycle circuit and a balanced current for all three phases of the 400-cycle circuit. The substantial spare capacity in each of the circuits designated here has been found to be necessary to provide the flexibility and interchangeability required for data processing centers. And as more machines are added—over and above those specifically included in this initial design—the addition of more receptacle outlets will be a simple matter.

THREE PANELBOARDS serving the computers and receptacle circuits in the data processing area are installed in small room adjoining the area. Panels are (L-R): 3-pole 100-amp-frame, molded-case circuit-breaker panel for 120/208-volt, 60-cycle circuits run in wireway to outlets for the machines; 3-pole, 100-amp frame, molded-case circuit breaker panel for 120/208-volt, 400-cycle circuits, also run in wireway to outlets for the machines; and a 60-cycle, 120/208-volt panel for general-purpose receptacle circuits run under the raised floor. John Compton, foreman for Arc Electrical, is looking over the installation.

WIREWAY HOMERUNS for panelboard circuits were run from the underfloor wireway system, up, in the wall, to the bottom of the panel enclosure.


8"x 8"x 4" alum. box with hinged cover on wall–2'-6" above raised floor
Receptacle in cover
φA
9#6-2" alum. conduit (ckt.#3) under raised floor
12"x 30"x 8" J.B. with screw covers in top under raised floor
MAINTENANCE ROOM
1B (60 ~)
1A (400~)
1C (60 ~)
9#6 - ckt.#2
5#8 4#6 } ckt.#4
9#8 - ckt.#1
9#6 - ckt.#3
6"x10" wireway under raised floor
304
COMPUTER ROOM
332
320
523
Recept. under raised floor
2#12-¾"C to panel "1C"
340B
φB
φA
φC
9#8 - ckt.#1
6"x6" with screw covers
4-conductor No. 8 (3 phase wires & 1 ground) neoprene jacketed cable under raised floor
9#6 - ckt#3
6"x 6" with screw cover
332 332 332 332 332 332 332 332 332
380
340T
φC φA φB φC φA φB φC
6"x10" wireway under raised floor
Console
360
370
340M
402
330
Computer equipment
3 ft. slack up to machine

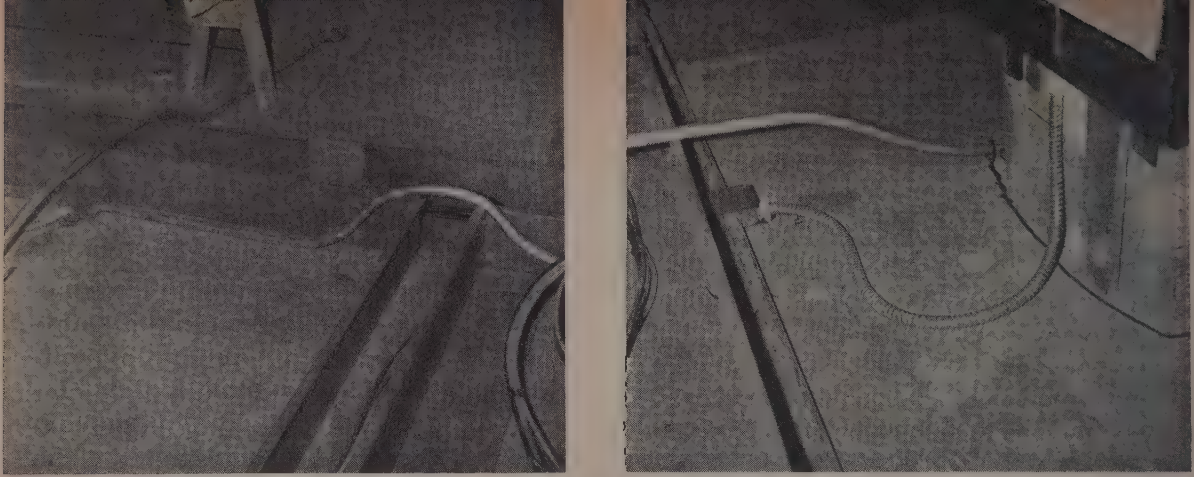
FLOOR PLAN of data processing area shows layout of wireways and locations of receptacle outlets. The phase designation alongside each receptacle symbol —e.g., φA, φB or φC—indicates which phase of the 60-cycle circuit is tapped to that particular receptacle. The arrow from each receptacle symbol points to the machine supplied from that receptacle. This grid layout of wireway can provide for installation of receptacles at any location, as necessary to serve machines anywhere in the area. The nine conductors for each circuit include three phases and a neutral for 60-cycle supply, three phases and a neutral for 400-cycle supply and a separate ground wire (either No. 8 or No. 6).

Electric power is fed to the computer room at two voltage levels. Fluorescent lighting is derived from 480/277-volt panelboards fed from the main distribution panel in the sub-basement. Three panels in a small room adjoining the computer room supply the necessary 120/208-volt power for the computers and receptacle outlets. The wall-mounted and column-mounted receptacle outlets are derived from a 120/208-volt panel fed from the 75-kva transformer in the sub-basement. And circuits for the computer machines originate from two 120/208-volt panels. One of these panels supplies 60-cycle, 120/208-volt, 3-phase, 4-wire circuits and is fed from the 112½-kva transformer in the sub-basement. The other computer panel supplies 400-cycle, 120/208-volt, 3-phase, 4-wire circuits, fed from an M-G set.

The 400-cycle power for the computer machines originates at a motor-generator set in a small room in the lower level. This M-G set is driven by a 75-hp, 440-volt, 3-phase motor supplied from the main distribution panel in the sub-basement. The motor is controlled through a part-winding starter to reduce voltage disturbances by reducing the starting current. The motor drives a generator with a 400-cycle 3-phase, 4-wire, 120/208-volt output rated at 50 kva, 40 kw, 80% power factor. From the generator output, a feeder of four No. 3/0 RHW conductors are carried in aluminum conduit up to the 400-cycle panel for the computer loads.

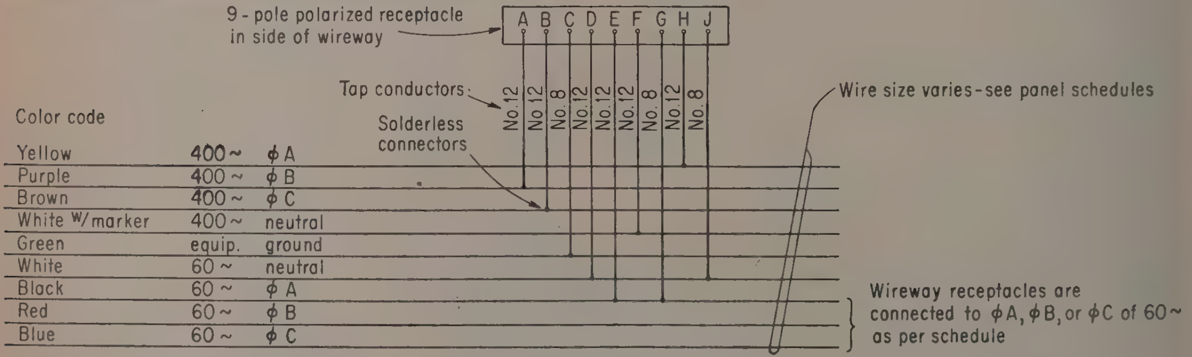
Wiring from the three computer room panelboards is made under the "floating floor" used throughout the computer area. This type of floor has become a standard floor construction method for use in data processing centers. The floor consists of 18¼-in. square cast aluminum panels set on adjustable pedestals to form a rigid floor surface with a 15-in. space between it and the slab below. The space provides for highly flexible wiring layouts with cable circuits and affords ready relocation of load devices anywhere over the area of the floor. At each point of power cable feed to a machine, the floor

EQUIPMENT GROUNDING BLOCK in the 60-cycle computer panel is pointed out by Frank Aluisio, electrical design engineer for this extensive project. All ground wires from the individual machines are connected to this terminal block which, in turn, is connected to the sub-basement grounding electrode by the No. 2/0 grounding conductor run with the feeder to the panel. In this way, a solid, continuous path to ground is assured from every equipment housing in the computing area. Note the branch circuits from the panel feeding into the vertical section of wireway at the bottom right in the panel.



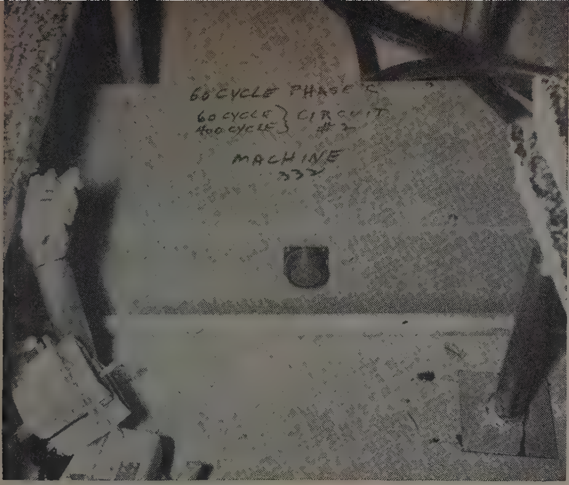
EARLY CONSTRUCTION photos of the computer area show (left) wireway set on floor slab before installation of raised floor and (right) the method of rigid conduit and flex taps for supplying each of the many column-mounted standard duplex receptacles installed in the computer area for miscellaneous plug-in load devices. These conduit circuits for peripheral receptacles are supplied from panel 1C.

TAP CONDUCTORS for each 9-pole receptacle outlet are spliced to circuit conductors in wireway (left) in accordance with panel schedule and as shown here in the typical connection diagram. Sections of the raised floor have been removed to reveal the wireway. Note that each of the cast aluminum floor panels is individually carpeted to give the overall floor a richly decorative appearance.

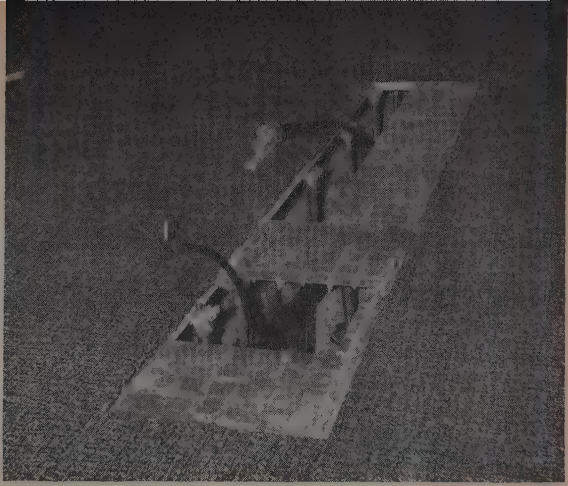

9 - pole polarized receptacle in side of wireway
A B C D E F G H J
Tap conductors
Solderless connectors
No.12 No.12 No.8 No.12 No.12 No.12 No.8 No.12 No.8
Wire size varies - see panel schedules
Color code
Yellow 400 ~ ϕA
Purple 400 ~ ϕB
Brown 400 ~ ϕC
White W/marker 400 ~ neutral
Green equip. ground
White 60 ~ neutral
Black 60 ~ ϕA
Red 60 ~ ϕB
Blue 60 ~ ϕC
Wireway receptacles are connected to ϕA, ϕB, or ϕC of 60 ~ as per schedule

panel is simply cut out to permit passage of the cable. And a protective plastic rim or grommet is placed around the edge of the opening to prevent abrasive damage to the cable insulation.

Here at the National Cash Register center, the underfloor wiring method was designed to meet the particular needs of the loads. Although other installations have used neoprene-jacketed cables laid at random under the floor or circuits in freely laid flexible metal conduit, wireway was selected as the most practical system in this case. This choice was dictated by the need for a relatively large number of small size feeds to machines. In other installations, a considerable load of computer machines could be handled by a single large circuit to a unit power supply. Then the individual machines which made up the computer system were simply cord-connected to the power supply. In this way, the number of circuits taken from the building wiring system was relatively small. On this National job,



TYPICAL 9-POLE OUTLET in wireway under the floor is a special receptacle for connection of a power cord for one of the computer machines. Each outlet is identified as to circuit number, 60-cycle phase and machine number.



MACHINE POSITION is ready for placing of machine, with power cord from wireway receptacle at front left and special interconnecting cable to hook the machine to an associated machine in the area.

however, there was need for a relatively large number of cord connections from the built-in wiring system to individual machines. In addition, the task was complicated by the fact that each machine required single-phase, 60-cycle, 120-volt power and 3-phase, 400-cycle, 120/208-volt power.

After much study of the problem, Frank Aluisio devised a method which would satisfy all of the various needs—an outlet for each machine, supply of both 60-cycle and 400-cycle power and ready flexibility for layout of machines in the computer area. Design called for a system of large size branch circuits run in wireway with small taps from the circuits to special 9-pole receptacles spaced along the sides of the wireway. With this hookup, any machine, anywhere in the computer area, can be powered by a 9-conductor cord run under the floor and connected by a matching plug to one of the 9-pole receptacles.

The multi-outlet branch circuits run in the wireway under the floating floor include 3-phase, 4-wire, 400-cycle circuits and 3-phase, 4-wire, 60-cycle circuits—all at 120/208 volts. There are 12 3-pole CBs in the 60-cycle panel and 12 3-pole CBs in the 400-cycle panel. There are both active and spare circuits in these panels, with extra capacity in the panels and in the wireway to adequately handle load growth of over 100% the initial demand load. Loading of circuits was made on the basis of equipment demand loads as provided by National. The circuit conductors include No. 6 RHW for 70-amp circuits and No. 8 RHW for 50-amp circuits. Tap conductors to the receptacles are No. 12s and No. 8s and are tapped from the circuit conductors in the wireway.

Each receptacle is supplied with: four No. 12s for the 3-phase, 4-wire, 400-cycle power; four conductors—two and two in parallel—for the 120-volt, single-phase, 60-cycle power required by each machine; and a separate equipment grounding conductor run as part of a continuous, high conductivity ground path back to a water-pipe in the main distribution room. The power cords used to carry power from the wireway receptacle outlet to each machine were supplied by National Cash Register with the machines. Other cables used solely for interconnecting various machines in the computer system were also provided by National.

In the initial design, outlets were designated for the machines to be used. An outlet was provided for each machine. Circuits were provided to supply groups of outlets, with the design demand load on each circuit taken as 100% of the sum of the demand loads of the receptacles served. Each circuit was carefully loaded to provide spare capacity, and the loads of single-phase, 60-cycle power were balanced among the three phases. Choice of the sizes of circuits and the number of outlets on each was based on economy in materials and labor and on the advantage of load separation to reduce the effects of power transients from one machine to another.

Many of the special design and construction details of this installation are shown in accompanying photographs and diagrams.

RAISED FLOOR provided a convenient place to locate the electrically driven air compressors which control opening of the entrance doors for the data center. This method of installation saved valuable floor space which would have been required to house the equipment and makes the equipment readily accessible for maintenance.

•ESTIMATING FORUM-XII

Estimating Productivity of Mechanics

Part II — Appraising the Individual

By **Ray Ashley**, *Research and Consulting Engineer, Oak Park, Ill.*

STATEMENTS: Contractors have two general methods of appraising a mechanic's ability: (1) by his current work record; (2) by his appearance, years employed as a mechanic, and the types of projects he has worked on in the past.

QUESTIONS: (a) Can opinions formed from either of the foregoing methods be taken as final?
(b) What factor influencing productivity is most likely to be overlooked?

ANSWERS: (a) No. There may be influences that temporarily reduce a mechanic's work output.
(b) Home life (a man's domestic life and off-job activities).

DISCUSSION:

False appraisals of productivity usually are a fault of management. A mechanic may be assigned to work for which he is not well adapted. He may be with a below-normal crew. His health and mental attitude may have been temporarily out of line.

There might have been a shortage of tools and good working drawings on the job, or the progress of the general contractor might have retarded all pipe trades. And, the costly effect of untimely material deliveries must never be overlooked.

To get a true picture of a man's ability, management should permit him to work on several jobs under varying conditions.

Appraising a mechanic's ability to be a foreman embraces much more than merely assigning a rating to his productivity as an individual workman. His initiative, capacity for directing others, and many other qualifications must be considered.

The layman may question the electrical contractor's apparent failure to require letters of recommendation of new mechanics. While this may be standard practice in other fields, it just is not done in the building trades. A mechanic considers his union card sufficient evidence of his training and ability. And, contractors generally prefer to get their information first-hand.

The accompanying list of Factors Affecting Productivity indicates pertinent items that should be considered. The first two, "Physical Qualifications" and "Education and Training" usually can be determined with a short interview. "Propensity" and "Disposition" can be anticipated with reasonable accuracy.

Speculating on a man's attitude is much more difficult. Only after a mechanic has been working on a project, can management actually give him a rating (for faithfulness, dedication to work, etc.). A detailed discussion of Attitude of Mechanics appears in Part I (EC&M, April 1961, page 89).

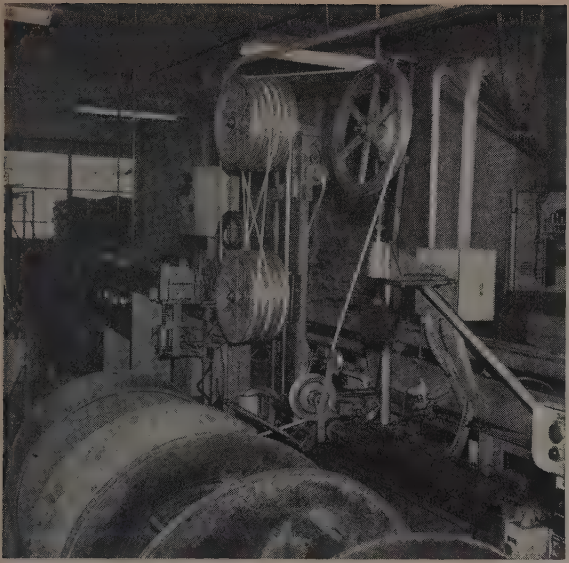
Home Life A Factor

Home life, the last item in the list, is a very delicate subject with many ramifications. It covers the

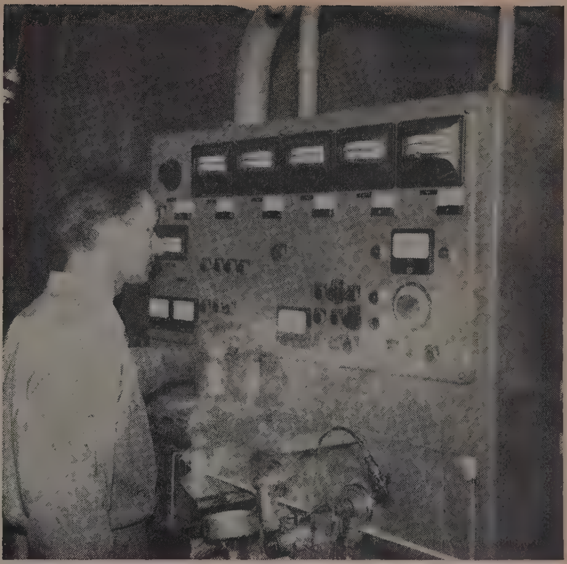
(Continued on page 149)

FACTORS AFFECTING PRODUCTIVITY
(Manpower)

Item	Remarks
Physical Qualifications	Depends on type of work
Education and Training	Includes job experience
Natural Propensity	Skill and initiative
Disposition	Ability to get along with others.
Attitude	Desire to produce
Home Life	Includes off-job activities



EXTRUDING LINE is highly automated. Here, in one continuous operation, copper wire is insulated, tested and wound on reels. Electric equipment ranges from delicate photo-cells, which check insulation thickness, to 36 kw of strip heaters that heat plastic insulation prior to application. Electronic controls (in right background) regulate reel speeds; require occasional adjustments as tube and component values change.



CENTRAL CONTROL CONSOLE for extruding line allows operator to monitor process as wire is being insulated. Dial thermometers, at top of panel, give temperature readings in adjacent molten-plastic oven, which is heated by strip-heating elements. Ammeters, connected in the heater circuitry, indicate heater circuit current. Defective heaters are easily detected when the operator notes deviations.

Practical planning results in . . .

Effective Small-Plant Maintenance

Here's how one engineer provides economical and effective maintenance in a small, 50-employee manufacturing plant.

By Robert J. Lawrie

PLANT Superintendent Bill Zimmerman, American Metal Moulding Co., Irvington, N. J. gets top-mileage production from old and new equipment. His electrical maintenance procedures are the result of his constant effort to improve production performance coupled with many years of experience. Here in this 50-employee plant, where time and labor are at a premium, a frank evaluation of his own capabilities is the key to economical yet effective maintenance.

Utilizing 35,000 sq ft of space, AMMCO produces all standard sizes of armored cable and flexible metallic conduit. Manufacturing equipment includes coilers, twisters and paper-wrap machines, some of which have been installed for many years. In addition, they have a modern electronically controlled extruding line, which applies plastic insulation to copper wire. Other facilities include high-voltage test apparatus and a large machine shop.

Maintenance of this diversified equipment is primarily a two-man plan. A maintenance man performs electrical PM and repairs under the direction of Bill Zimmerman, who manages the production department and is responsible for engineering and maintenance.

To find out just how Bill Zimmerman handles electrical maintenance, what his problems are and

Second in a series of articles on current industrial electrical maintenance. The first study was "Effective Large-Plant Maintenance," in the April issue. The series covers operating procedures and work methods in typical industrial plants through personal interviews with key plant personnel.

how he solves them, we visited his plant and sought his replies to a series of questions.

How is your electrical maintenance program organized?

We have one maintenance man and myself. The two of us handle all the maintenance required to keep production going. I plan the maintenance programs and equipment installations or changes, keep certain records and perform some troubleshooting. The maintenance man performs routine procedures including inspection and lubrication of equipment, does various odd jobs and troubleshoots equipment.

Do you find electrical maintenance more difficult than mechanical maintenance?

No. As an electrical engineer I have a good background in electrical theory and after 16 years with this company, I have gained practical experience, which assists me in planning proper electrical maintenance and in troubleshooting equipment. My maintenance man has a good practical knowledge of electrical equipment.

What kind of power distribution and equipment do you have?

Both of our buildings are energized at 230 volts 3-phase. Fed through an 800-amp main switch, the main manufacturing and warehouse building has an ungrounded 230-volt, 3-phase power distribution system. Our second building, which houses the automatic extruding line and high-voltage testing facilities, receives power through a 600-amp main switch. From these main switches, feeders branch out to various disconnect switches spotted near their equipment. Located at the main switches, ground detectors will indicate if a ground occurs.

In addition, we have several motors fed at 230 volts 2-phase. At one time, 2-phase power supplied all of our equipment. We have been gradually replacing this 2-phase equipment with 3-phase equipment. And we were able to make this change economically with a static phase converter.

Why did you select a phase converter to make this changeover?

Primarily to avoid a large capital outlay and to avert a lengthy downtime. Here are the details.

In our early days of operation the power company supplied us with 230 volts 2-phase. And, for some time, operation and maintenance of our motors were satisfactory. But as the years went by, the 2-phase motors that burned out were becoming increasingly difficult to replace, and their cost was somewhat higher than standard 3-phase motors. And, because most new equipment was designed for 3-phase operation, we decided that we should have a 3-phase supply. But a complete changeover to 3-phase meant that we would have to bear the cost of not only a completely revamped power distribution system but also the cost of new motors for most of our equipment. So we purchased a 2-phase to 3-phase converter, which we connected to supply 3-phase power to a certain section of the shop. Whenever a 2-phase motor burned out, it was replaced with a 3-phase motor or rewound 3-phase. If the motor that failed was not near our 3-phase area, we then would switch motors on a machine that was in that area.

The convertor was sized to handle about half of our motor load. When half of our motors were supplied through the convertor, we had the power company change our service from 2-phase to 3-phase. At the same time, we reversed the connections on the phase convertor to supply 2-phase to the remaining 2-phase motors. We are continuing to replace 2-phase motors with 3-phase motors, and eventually, all of our equipment will be 3-phase.

What equipment gives you the most trouble and how do you handle it?

Motors are the most frequent offenders. When a motor fails, we'll check the following: (1) driven load for binding; (2) overload relays; (3) fuses; (4) line voltage. If these check out all right, the motor is brought to our repair shop where we'll look at the windings and check the bearings. If the bearing is at fault we'll replace it ourselves. If the motor winding is burned out, we'll send it out to a motor shop.

Do you have an electrical preventive maintenance program?

Yes. Our electrical PM consists mostly of visual inspections. It starts with the machine operators who inspect their equipment daily. If during operation they hear or see anything unusual, they will notify me. The maintenance man will inspect more complex equipment periodically. I inspect the electronically controlled extruding line daily. This is high-production equipment; once it's started it runs continuously. Here, we replace all electronic tubes every 1½ years.

At least once a year, the maintenance man will pull each motor, clean and lubricate it, and check bearings. If motor insulation looks brittle or is cracked, the motor is sent out for re-insulation.

Don't you think that you'd have less bearing failures if you lubricated motors more than once a year?

Probably slightly less. In the past we've lubricated motors more often than annually. But whether we lubricate annually, quarterly, or

OVERHEATING OF MOTOR may be caused by (1) too large a load, (2) binding or misalignment of motor drives, (3) bad bearings, (4) shorted winding. Here, a maintenance man checks temperature of a 5-hp induction motor. Annually, this motor is taken apart, cleaned and lubricated.

monthly, the number of bearing failures is virtually the same.

What electrical PM do you perform on your power distribution lines and switches?

Once a year the maintenance man will clean out the switches and make a visual inspection. We've had so little trouble with our distribution lines that I feel it isn't worthwhile to take time to Megger them. Besides, if we do have trouble on our comparatively small distribution system, it wouldn't take us long to replace a bad line.

How do you manage your electrical maintenance paperwork and records?

Because I have so many other responsibilities, I keep a minimum of records. I have all my equipment catalogued. When we have trouble with a machine, I'll list the date, cause of malfunction and how we repaired it. I also record our yearly motor inspections as they come due.

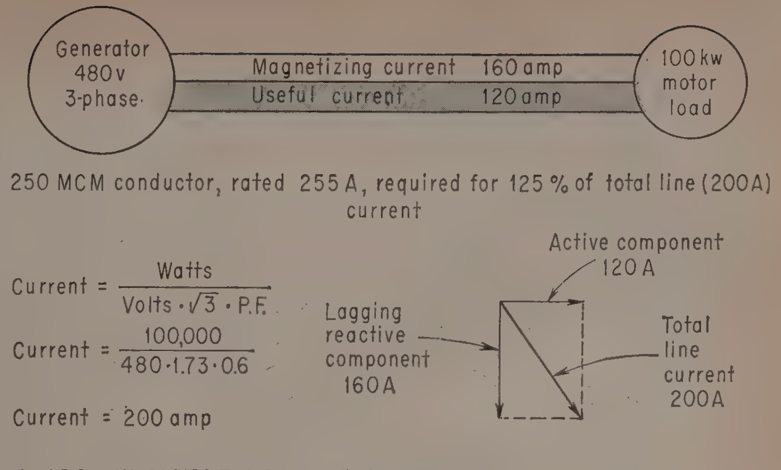
During his daily routine, the maintenance man will mark in his logbook any deviation from normal that he might find. And I have my listings of spare parts.

What spare parts do you keep?

Because we have about 100 motors—1 hp through 60 hp—and about 35 fractional hp motors, we stock about 10 spare motors in the range of 2, 3, and 5 hp. For our fractional hp motors, we keep at least one spare motor of each size. In addition, we stock standard spare parts such as motor bearings, contactors, relays, electron tubes and fuses. The maintenance man keeps the spare parts records.

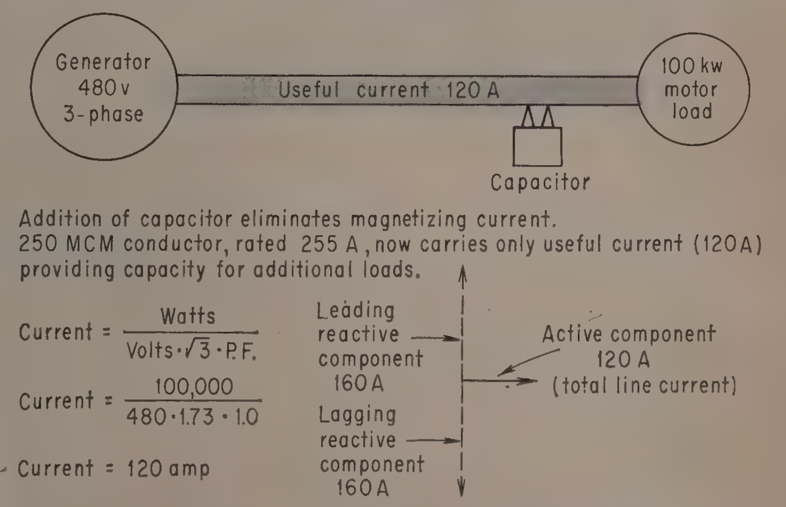
What special electrical problems have you had?

As demands for armored cable increased, we were required to enlarge our production capacity. This meant the addition of more motors to our already heavily loaded power distribution system. And, because these motors have a high starting current and operate at low power factor, it appeared that we would have to increase our power-system capacity to avoid voltage drop and to stay within the power company's maximum of 150 kva for an individual service. We did increase the system capacity—but we did it with capacitors.


Generator
480 v
3-phase
Magnetizing current 160 amp
Useful current 120 amp
100 kw motor load
Current = Watts / Volts · √3 · P.F.
Current = 100,000 / 480 · 1.73 · 0.6
Current = 200 amp
Active component 120 A
Lagging reactive component 160 A
Total line current 200 A

250 MCM conductor, rated 255 A, required for 125% of total line (200A) current

A. 100-KW MOTOR LOAD AT 0.6 POWER FACTOR


Generator
480 v
3-phase
Useful current 120 A
100 kw motor load
Capacitor
Current = Watts / Volts · √3 · P.F.
Current = 100,000 / 480 · 1.73 · 1.0
Current = 120 amp
Leading reactive component 160 A
Lagging reactive component 160 A
Active component 120 A (total line current)

Addition of capacitor eliminates magnetizing current.
250 MCM conductor, rated 255 A, now carries only useful current (120 A) providing capacity for additional loads.

B. 100-KW MOTOR LOAD CAPACITOR CORRECTED TO 1.0 POWER FACTOR

THEORETICAL EXAMPLE shows how conductor capacity can be increased by the addition of capacitors. In A, the .6 PF motor load draws a 200-amp line current requiring a 250 MCM conductor. In B, the leading current, supplied by the capacitor, cancels the motor's inherent lagging current. Thus the total line-current vector of 200 amps (shown in A) is eliminated leaving only the active current of 120 amps. This means that the addition of capacitors has reduced the current carried by the 250 MCM cable thus providing capacity for additional loads.

Realizing that our already poor power factor would become even lower after the proposed expansion, we decided to install capacitors which would improve power factor thereby reducing reactive current. Thus the power system capacity would be increased. We installed 230-volt, oil-filled capacitors at the motor branch circuits and at the same time we installed our new motors. Enough capacitors were installed to keep our current draw within circuit ratings and within the power company's requirements. Our power factor is now excellent. Of course, we may eventually have to enlarge the power distribution system, but this capacitor addition was advantageous for three reasons: (1) We weren't required to install a new and larger power distribution system immediately, thereby saving a large capital outlay; (2) Capacitors will be useful as power-factor correction even if the power system is enlarged later; (3) We were able to perform all work ourselves.

Do you have an electrical safety program?

We have safety rules that our high-voltage test people must follow and I spot-check the maintenance man on electrical safety rules. On the high-voltage test apparatus, safety interlocks protect the testers from shocks. This interlock system is foolproof. It is so designed that if any one of the interlocks is malfunctioning, power cannot be obtained. If any high-voltage test equipment is not operating properly, I check it myself.

Modern Techniques Help Answer the Question:

How Much Can a Guy Anchor Hold?

Anchoring of poles and structures for outside distribution is becoming an exact science as more and more is being learned about how anchors develop their holding power.

By **W. L. Hollander,** *Senior Project Engineer, Anchors*
and **Ray Martin,** *Chief Engineer, Line Construction Materials, A. B. Chance Company*

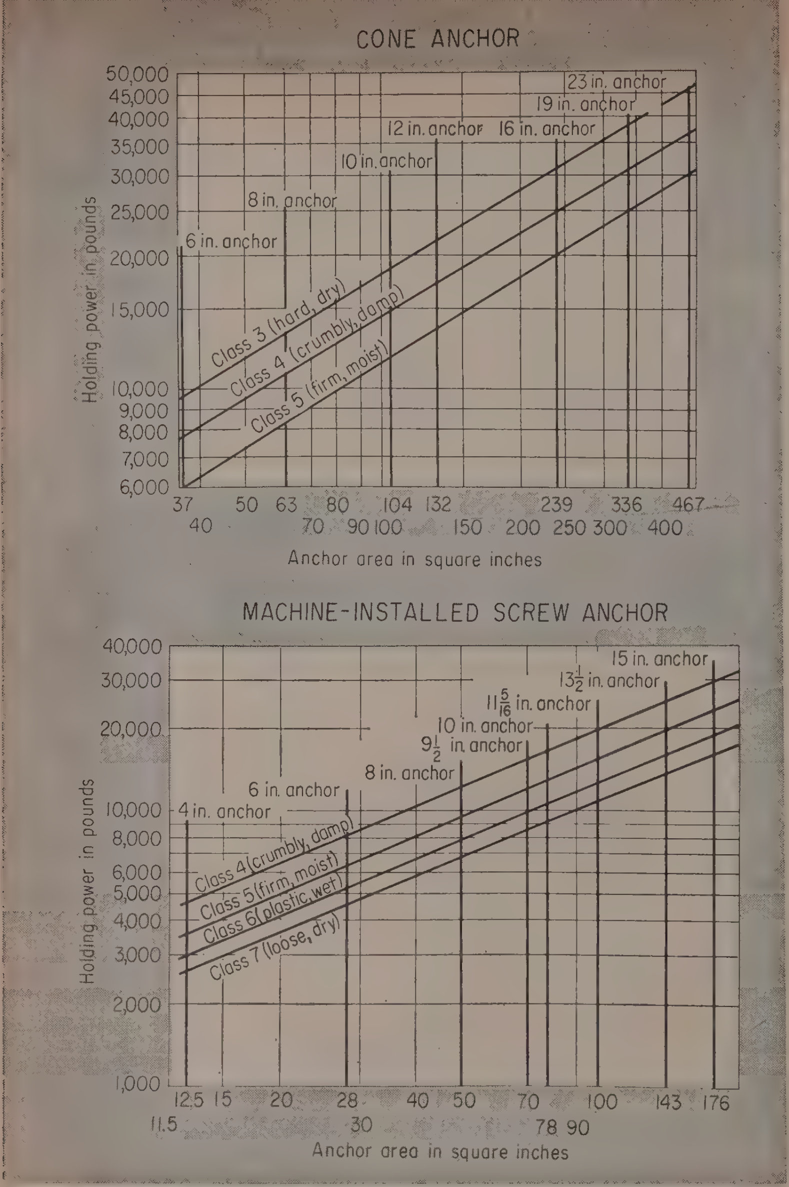


FIG. 1—Holding power of an anchor depends both upon its size and viscosity of soil in which it is installed, according to earth-dynamic theory. Here, allowable loadings on various sizes of common types of anchors are plotted against classes of soil graded according to viscosity. Rated loading in each case is that sustained with total creepage less than 4 to 6 in.

HOLDING power and creep of a guy anchor buried in soil can be explained fairly accurately by principles that might be called "earth dynamics." A well-tamped anchor can creep only as the soil restraining its motion flows under enormous pressure out and around edges of the anchor to fill in the void below the anchor caused by its motion. In other words, movement of anchors in soil under tension can be compared with movement of objects in an extremely viscous fluid. Applicability of this principle has been indicated many times in field tests when anchors installed with voids on their undersides have crept under much lower tensions than have anchors installed under identical conditions but with no voids.

One of the first principles in calculation of anchor holding power to be questioned through use of the earth-dynamics concept was the theory that pull-out tension depended upon weight of an inverted cone of earth with the anchor as vertex and surface of the ground as base. The inverted-cone-of-earth theory predicates that anchor holding power will increase in setting depth. However, in practice, an increase in depth may result in an increase; in no charge; or in an actual decrease of holding power. Viscosity of the soil should be the major factor in determining holding power and creep of an anchor if the new philosophy were correct. This has proved to be the case. A whole new method of evaluating holding power and creep of anchors has been evolved, based upon viscosity of soils in which they are buried.

Soil Classifications

Soils have been classified, as shown in Table I, into eight types depending upon their viscosity, and holding power of anchors determined for each class of soil. Thus, an anchor that might develop 25,000 lb of holding power in Class-3 soil of hardpan could hold perhaps 10,000 lb in dry, Class-7 sand.

Correlation of anchor holding power according to soil viscosity classification has been proven by many tests where anchors have actually been loaded and creep has been measured. Fig. 1 shows typical variations in holding force for anchors in different soils. It has been found that so long as 2 ft of a particular class of soil lie over the anchor when it is installed, holding power of the anchor remains within rating for that class of soil. This is so even if strata of other soil classifications are above or below the stratum where the anchor is located. In all cases, the anchor should be set deep enough to avoid variations due to seasonal change. This emphasizes importance of knowing general soil conditions when a group of anchors is to be installed or of determining soil classes at various depths at specific locations where particularly important anchorages are to be made.

Thus, there might be an overlay of 4 or 5 ft of damp, marshy soil of Class 7 or 8 over a much firmer soil of Class 5 or 6. Installing the anchor just 2 or 3 ft beyond the more fluid soil into firmer soil could, in some cases, double its holding power. On the other hand, an extra few feet of anchor depth might take it well into a softer stratum, reducing its holding power.

Core drilling or a new earth probe recently made available can give accurate readings of soil characteristics and holding power (Fig. 3). The earth probe measures torque required to twist an earth bit into the ground. Correlation between torque required and class of soil has been established with considerable accuracy so that holding powers of anchors at depths tested are assured.

The earth-dynamics theory also points out necessity for well-tamped backfill. Even the most dense of soils degrade several classes if backfilled carelessly.

Another old idea, now abandoned, was that force required to pull an anchor completely out of the ground was a measure of anchor merit. It is true that a well-designed, large anchor, properly installed, will require more force to pull it out of the ground than will a small or improperly installed anchor. However, the damage is done by a shifting anchor long before it emerges from the ground. Merit of an anchorage is provided in the first 4 to 6 in. of creep. Beyond this point structures pull out of line, and conductor spans sag to a point where the anchor can be considered to have failed even though it may still be far below the surface of the ground.

Creep-vs-Time

Field tests have established creep-vs-time characteristics of properly-installed anchors, as shown in Fig. 2. It has been found that once anchor guys have been stressed at some 2000 lb to compact the earth and to set or bed the anchor, additional creep under load diminishes rapidly with time until a plateau is established for any given loading within the rating of the anchor. If loading is now increased considerably but within rating of soil and anchor, a small amount of additional creep will occur but equilib-

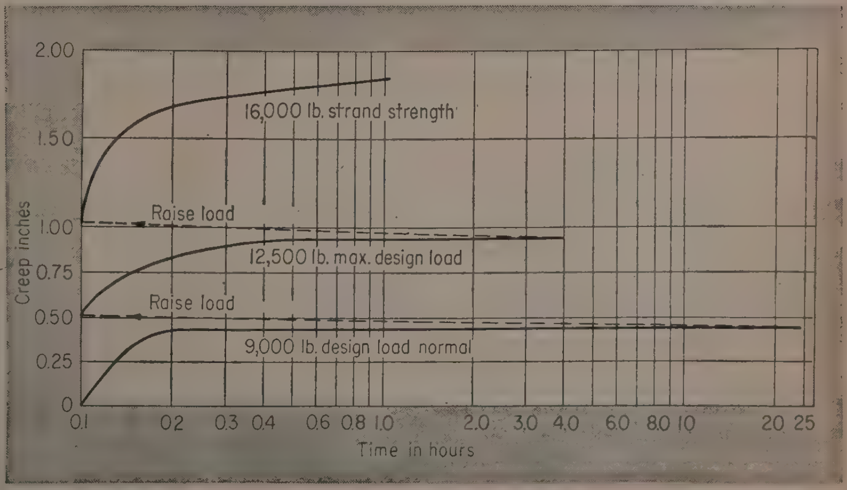


FIG. 2—These tests show that creep of an anchor occurs in first few minutes of loading after which anchor establishes equilibrium as soil compacts. Tests were made on a 143-sq-in., power-installed screw anchor installed in Class-6 soil at 45 degrees. Rated ultimate holding strength of this anchor in Class-6 soil is 17,000 lb.

FIG. 3—This earth probe measures torque required to twist it into the earth. Direct correlation between torque as determined by this probe and soil classifications gives an accurate measure of anchor holding power at strata found at different depths below surface of the ground.

TABLE 1 -- SOIL CLASSIFICATION DATA

CLASS	DESCRIPTION OF SOIL	PROBE VALUE
1	Solid Bed Rock	------
2	Laminated Rock; Slate; Schist; Sandstone	------
3	Shale; Broken Bed Rock; Hardpan; Compact, Clay-Gravel Mixtures	Over 500 in.-lbs.
4	Gravel, Compact Gravel and Sand; Claypan	400-500 in.-lbs.
5	Medium-Firm Clay; Loose Sand and Gravel; Compact Coarse Sand	300-400 in.-lbs.
6*	Soft-Plastic Clay; Loose Coarse Sand; Clayey Silt; Compact Fine Sand	200-300 in.-lbs.
7	Fill; Loose Fine Sand; Wet Clays; Silt	100-200 in.-lbs.
8**	Swamp; Marsh; Saturated Silt; Humus	Under 100 in.- lbs.

*Includes areas only seasonally wet with slow drain as in fairly flat terrain.
**Install anchors deep enough, by the use of extensions, to penetrate a Class 5, 6, or 7 underlying the Class 8 Soil.

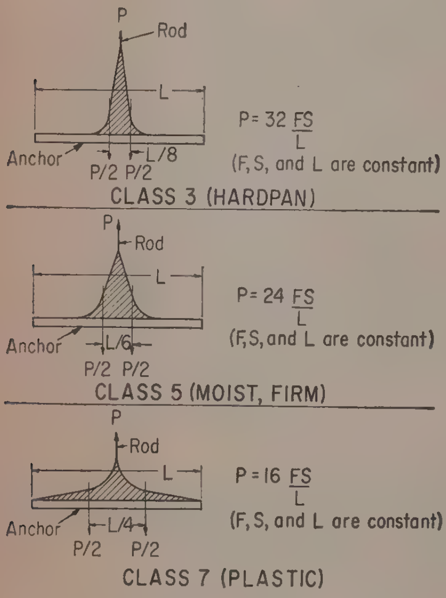


FIG. 4—Ultimate strength of an anchor itself is reached at lower loadings in soft soil than in hardpan. Illustration shows how effective lever arms of earth-reaction forces are short in hardpan, keeping bending moment and maximum fiber stress to a minimum. Soft soil flows along the surface of anchor, increasing length of lever arms to centers of gravity of earth-reaction forces, which, in turn, increase bending moment and fiber stress. Anchors are designed for ample strength in all working conditions in any type of soil.

rium will again be established at a new plateau well within limits of tolerable creep. Measurement of effective creep of an anchor at rated maximum working load thus provides a far more realistic evaluation of anchor merit than does determination of pull out strength.

A curious fact about ultimate physical strength of anchors has become evident from test data. It now becomes apparent that viscosity of the soil has just the opposite effect on ultimate strength of anchor structures as it does on their holding power. The more viscous the soil, the higher becomes ultimate strength of an anchor itself before physical damage is received. Formerly, before soil viscosity was considered, an anchor that received physical damage at low total load was automatically considered defective.

The old idea was that unit loading on an anchor would be uniform over its entire surface. Under this theory, structural failure should always occur at the same load since bending moment equals section modulus times extreme fiber stress. But, under the earth dynamics theory, unit loading over the surface of the anchor should vary because of earth flow. There must be a flow of earth over edges of the anchor from the loaded side to the back, or unloaded side of the anchor. Effect of this flow is to shift earth-resisting forces away from point of application of load at the rod toward outside edges of the anchor.

It has been proven that the rod will fail without damage to the anchor in most pull tests on anchors in hardpan. This is because bending moment on the anchor in hardpan for a given load on the rod is low since hardpan is highly viscous and reactions by the earth are centered close to the rod as shown in Fig. 4. But as soil becomes less viscous, as in plastic clays, reaction points in the resisting earth shift outward, increasing effective moment arms; and the load, which produces maximum or destructive bending moment, is reduced.

Anchors are designed to be amply adequate for actual working conditions. Thus, limitations due to structural strength of anchors are of academic interest only since, for a given type of soil, loads would be limited by maximum allowable creep which would occur far before ultimate strength of the anchor itself was reached.

Characteristics of a mechanical system as a whole including sags, tensions, and deflections can be controlled more precisely for given load conditions now that performance of anchors in various kinds of soils can be predicted accurately. Modern anchorage techniques and equipment that can be matched with a high degree of accuracy to mechanical design considerations of overhead structures result, not only in more coordinated systems but also in lower overall costs since over-design to compensate for unknown factors can be effectively eliminated.

Two-Way Radio Cuts Contractor's Costs

Here's how a 2-way radio system is integrated with everyday operations of Jackson Electric Company, Perrine, Fla.—adding real economies by reducing costs of vehicle operation and boosting capacity and efficiency of work.

HEADQUARTERS OPERATOR of two-way radio system is Millie Kane, who coordinates daily job requirements with movement of company personnel in the field.

TYPICAL APPLICATION of 2-way radio finds the company superintendent at the job site, using the system to secure quick solution to problem that has come up.

GASOLINE bills weigh heavily on expense sheets when a fleet of trucks is operating every day within a 30-mile radius. Any method of lowering these costs is worth serious consideration, and that's why Jack Kane thought long and hard when a two-way radio system was proposed in early 1960.

Kane and his wife are co-owners of Jackson Electric Company in Perrine, Fla., about 20 miles south of Miami. The Kanes took over ownership of Jackson Electric in the spring of 1956 and turned a faltering operation into a growing business. At the start, the company consisted of two men, including Jack, one truck, and a barrelful of know-how. First customers were largely packing firms in the area. Presently, Jackson Electric employs eight men and utilizes five vehicles. Operations span an approximate 30 mile radius of Perrine.

A growing fleet meant growing gasoline bills, so to put a stop to the latter rise, the Kanes installed a mobile radio network in the summer of 1960. Radios were put in three vehicles—Kane's car, the superintendent's pickup and a crew truck. A six-month report revealed that over-all gasoline costs have been slashed one-third.

"The money saved on gasoline cost is more than the cost of the radio system, when breaking the investment down to monthly payments," said Mrs. Millie Kane. "Instantaneous contact with the trucks to bring about pinpoint coordination has been the key factor in knocking the miles off," added Kane. "When a rush job comes in, we relay it to the radio-equipped crew truck if it is working near the site of the request," said Kane. "If the radio truck isn't nearby, the order is radioed to the superintendent, Buzz Guseman, who gets in touch with the non-radio-equipped truck in the best position to handle the job," Kane continued.

Radio is the "right hand man" of the superintendent in dispatching his various crews to jobs and overseeing the work. He is literally routed from project to project by radio to straighten out problems that occur and to provide material vitally needed to keep a job from slowing down. After completing its initial assignment at the start of the day, the radio-equipped crew truck is routed from project to project by radio. Jobs near the location of the truck are relayed by radio to eliminate backtracking.

"Radio saved this crew 60 miles of needless traveling recently," said Mrs. Kane. The crew, finishing a job, started out for another job 30 miles away. At that moment, Mrs. Kane received a request for work only a few blocks from the site of the job just finished. The request was relayed to the crew which handled the job before moving to the project 30 miles away.

With radio, Jack Kane has an office away from the office. On the road much of the time, he keeps in touch by radio, providing answers to problems posed by employees or customers, confirming appointments or handling administrative details that arise while he is traveling.

Another gas saver is derived from the types of radios being used by Jackson Electric. The company has installed transistor units. Extensive use of transistors has achieved low power-drain characteristics. This means the radios can be monitored for important messages while vehicles are parked on jobs without idling the engines. Not only is less gasoline consumed, but engine wear and tear is reduced considerably. The units are Motorola "Private-Line" Radios. This feature minimizes co-channel interference. When on a job, it means the crew can devote full time to its work rather than keep one man near the radio to listen to every message that comes over.

Selling Electric Home Heating

What the electrical contractor can do to remain competitive.

By Stuart M. Rich, *DBA, Asst. Professor of Economics, Wisconsin State College, Whitewater, Wis.*

THE electrical contractor is selling and installing more electric home heating in the United States today than are all other businesses handling this equipment put together. He is the logical sales outlet for electric home heating. Builders look to him for electrical wiring, equipment, and for all types of installation work involving electricity. Homeowners look to him for similar services as well as for wiring changes, repairs, and additions that may be necessary. Electrical wholesalers and manufacturers of electrical equipment regard him as the backbone of their retail distribution organization. In fact it is the law, in many communities, that all electrical work in new homes or apartment buildings being constructed be done by a licensed electrician—usually operating as an electrical contractor or employed by an electrical contracting firm.

The Electric Heating Forum is designed to provide a means of industry-wide communication on electric heating practices and problems.

The all-important role of the electrical contractor in extending the use of electric heat is emphasized this month, together with suggested selling techniques. The series on moisture and humidity continues with a discussion of vapor barriers.

Readers are invited to express their opintions; relate their own experience data to the material presented; or submit new ideas, research data, or case studies on any aspect of electric heating. Please address correspondence to:

Electric Heating Forum
Electrical Construction and Maintenance
330 W. 42nd Street
New York 36, N. Y.

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While the present competitive position of electrical contractors generally appears to be a strong one, it is by no means assured. Even in those sections of the United States (primarily the South and the Pacific Northwest) where the sale and installation of electric home-heating equipment has been firmly established as an electrical contractor item, competing channels of distribution are active and often are aggressively seeking to garner more of this business for themselves. Competitive pressures for the direct sale of equipment by manufacturers to builders and general contractors are ever-present and appear to be intensifying in some areas.

Traditional supply sources and retail outlets are being circumvented or replaced by "newer" competitors. Many of the old, established heating contractors are finding their own markets becoming less profitable and are seeking new business by taking on electric home heating. Appliance dealers, increasingly caught in the vise-like squeeze of intense price competition and rising costs, are starting to handle electrical heating equipment, especially in those areas where electric house heating has already achieved widespread acceptance. Electric heating specialists, who not only act as distributors or manufacturers' outlets for this equipment but also engineer and install the jobs themselves, are aggressively promoting electric home heating, particularly in the Middle West where they have "taken over first place" from the electrical contractor—in many cases by default.

The implications in all of these competitive developments are quite apparent. Unless the electrical contractor is able to remain competitive in price and in the services he performs, and unless he is progressive in the technical and managerial phases of his business and aggressive in his sales and promotional approach to the market situation in which he finds himself, his position will be open to attack from all quarters.

What then can the electrical contractor do to remain competitive and to improve his position as the leader in the sale and installation of residential electric space heating equipment? Following is a "20-Point Program" outlining some steps of action which an electrical contractor might consider if he wishes to build up his electric home heating business.

1. Let the public know that he is in this business. This calls for a vigorous program of advertising, personal selling, and sales promotion. These factors are outlined in more detail in the sections that follow.

2. Develop an advertising program. Included under this category would be regular newspaper ads, participation in co-operative advertising with manufacturers or their distributors, direct mailing to customers and prospects, and ads in the yellow pages of local telephone directories. Television also can be a very effective medium for getting across the electric home-heating story to the general public. The advertising theme, in general, should stress the benefits of electric home heating and should make effective use of installation and operating cost data, successful case studies, testimonials, etc.

3. Make use of personal selling. The electrical contractor who wishes to increase his over-all volume of business, including electric home heating, might seriously consider employing a full-time salesman or a combination salesman and electrician. This man should have the technical knowledge and training to discuss electric heating in detail with customers and prospects, to recommend equipment, and to make estimates of job requirements and costs. He should be skilled in sales prospecting and in the use of effective selling techniques and should also be able to demonstrate the features and performance of electric heating equipment.

4. Develop effective sales promotion. The electrical contractor should stress electric heating sales promotion and develop a planned program along this line. Such a program might include participation in home shows and fairs (state, county, 4-H, etc.), co-operation in model all-electric homes and open-house demonstrations, effective store displays, participation in trade shows and manufacturer- and distributor-sponsored sales meetings, use of motion pictures and film-strips (where this is feasible) to demonstrate the features of electric home heating to customers and prospects, and an organized publicity campaign.

5. Know all of the advantages which electric house heating offers builders and homeowners and be able to present these convincingly and personally to all prospective customers.

6. Familiarize himself with all types of electrical home heating equipment (baseboard heaters, ceiling cable, wall units, ceiling heaters, and heat pumps). Know the advantages and limitations of each type as well as the best applications of each kind of equipment. He should be able to discuss this with prospective customers and be in a position to make recommendations which are appropriate under the circumstances. An electrical contractor who is actively engaged in the installation of electric home heating should know how to install all types of electric heating equipment. He should perfect the necessary mechanical (as well as electrical) skills required to do good installation work.

7. Be able to figure heat loss, size equipment, and generally engineer electric home heating jobs whenever such service can be performed. Some utilities, of course, provide this service for their customers, but the electrical contractor who can do this is in a position to get on the "inside track" with prospective users of electricity for home heating. In calculating electric home heating jobs, it is imperative that the electrical contractor closely adhere to the standards of equipment, workmanship, and insulation which have been established by the local electric utility company; i.e., the one serving the particular customers who are involved.

20 Steps to Effective Selling

- **Use**
  - Publicity
  - Advertising
  - Sales promotion
  - Personal contact
  - Inducements
  - Mass installation
- **Know**
  - Equipment
  - Design
- **Stress**
  - Advantages
  - Insulation
  - Supplementary Uses
  - Service
  - Quality
- **Work with**
  - Distributor
  - Builder
  - Utility
- **Handle**
  - 2 or 3 brands
  - Price package
  - Complete line
  - Heat pump and air conditioning

8. Offer a "price package" choice to prospective customers. Such a package might include one price figure for a straight electric heating installation, another for a complete wiring job, still another quotation for an all-electric home package, and perhaps an electric heating-insulation package. These price packages should contain a "quantity discount" feature so as to provide an inducement to prospective customers to buy the more complete package. With respect to insulation, this sort of work logically should be subcontracted to a regular insulation contractor—one who is an expert and is experienced in his field. But such work still can, and probably should, be channeled through electrical contractors as part of the over-all electric home-heating package.

9. Offer other inducements to prospective customers when competitive pressures become intense. These inducements might include, for example, some free wiring, a piece of free equipment, or free servicing of electric heating and other electrical equipment and appliances.

10. Develop economical methods of mass installation. In project bids, especially, it may be possible to cut costs by instituting "mass production" techniques. The writer was impressed by one contractor in the Tennessee Valley who was able to effect cost savings through specialization. He had one man doing nothing but estimating heat loss and sizing ceiling heating cables, a couple of others doing the stapling, and an electrician making the actual electrical connections.

11. Maintain standards of excellence in workmanship and avoid the use of shoddy materials. The contractor-dealer who is out for a "fast buck" not only hurts himself in the long run but sets back the cause of electric heating in the entire area. The conscientious electrical contractor should resist attempts and pressures to install inferior equipment and cheapen workmanship.

12. Stress, to builders and individual homeowners, the necessity of adequate insulation, meeting or exceeding the full standards of the utilities serving the area. The electrical contractor who is interested in building up his electric home-heating business should do all he can to discourage skimping on insulation; for substandard and inadequate insulation, resulting in unduly high operating costs, will inhibit the growth of residential electric space heating. Besides this, it is often the electrical contractor who receives the blame (and loss of good will) from unnecessarily high operating costs resulting from a poor insulation job even though the electrical work and equipment are of the highest caliber.

13. **Seek to develop supplemental, auxiliary, and conversion business,** in addition to complete electric home heating. This business is not only profitable in itself but may lead to additional complete home-heating jobs as users (and their neighbors and friends) become familiar with electric house heating.

14. **Handle a fairly complete line** of all major types of resistance electric heating equipment in at least two basic price ranges (one of top quality and the other more moderately priced but still of good quality). One of these might be a "name brand" line and the other a "promotional" line. In some cases, where competitive pressures are forcing quoted bids down (especially on project jobs), electrical contractors may have to handle a line which is sold "direct from the factory" or lose the job altogether.

15. **Standardize on two or three brands.** This way an electrical contractor can familiarize himself with the equipment of two or three manufacturers and effectively promote these brands. By doing so, he will ordinarily be able to get faster delivery and more complete stocking from his regular distributor, who will maintain a larger and more complete inventory of equipment which is in steady demand. Since electrical distributors can qualify for significant quantity discounts, freight savings, and sales promotional aid by placing large orders with manufacturers, it is generally advantageous for these distributors to standardize as much as possible. Some of these cost savings may be passed along to electrical contractors in the form of discounts, promotional aids, etc. Electrical contractors who stock and push a particular brand may also qualify for sales and promotional aid from the manufacturer.

16. **Support the regular electrical distributor channel.** This is the source of supply to which the electrical contractor normally turns for most of his requirements. It is the distributor who maintains a large inventory of electrical equipment in the principal market centers, extends credit to dealers and contractors, provides continuous sales and delivery services, stands back of all equipment which he handles, etc. Without these important distributor services, electrical contractors would soon find that they would either have to provide some of them themselves (at a greater cost and with less efficiency, for the most part), or pay a premium to manufacturers to do so. The inevitable result of a policy of regularly by-passing the electrical wholesaler would be high over-all costs and a deterioration of service to builders and homeowners.

17. **Work closely with local electric power companies** and encourage these utilities to promote electric home heating. There are many important ways in which electric utility companies can promote residential electric space heating. Among these are lower rates (either in the form of a special rate for electric home heating or a low rate block for large consumers of electricity), cash allowances for installing electric heating, budget billing, an active selling and sales promotion campaign, advertising through mass media and direct mailing to customers, distributor and dealer training programs, the use of "case study books" showing the monthly operating costs incurred by electric house-heating customers, displays at home shows and fairs, utility company lobby displays, and open or model houses featuring electric space heating. The electric utility company that adopts all or even a substantial part of this powerful promotional package will have gained the enthusiastic support of all of its trade allies and aroused the interest of the entire community in electric home heating.

18. **Work with builders,** promoting their interest in electric home heating and selling them on his (the aggressive, promotion-minded electrical contractor's) ability to handle the supplying and installing of this equipment as a subcontractor. In the case of project building, where a number of electrically heated homes are going in, the electrical contractor or the builder can often save money by arranging for a drop shipment of heating equipment, delivered directly from the manufacturer to the construction site and billed through a local distributor.

19. **Be able to install heat pumps and air conditioning equipment.** This work is, of course, more technical than installing resistance heating equipment but it is profitable and will be performed by somebody—often a regular heating and air conditioning contractor. An electrical contractor who is interested in promoting electric home heating might seriously consider taking on one line of "packaged" heat pumps, representing the manufacturer exclusively. Most heat pump manufacturers will provide training for their dealers in the proper installation and servicing of their equipment. An electrical contractor is in a logical position to promote heat pumps and do the electrical work involved in their installation. Ductwork and plumbing can be subcontracted, if necessary, just as a regular heating contractor would subcontract his electrical work.

20. **Develop a strong service organization.** Resistance electric heating equipment generally requires little servicing, and even a complicated heat pump which is well made and properly installed may not require much servicing or repair. Nevertheless, when a customer needs repair work or maintenance done on his electrical heating system, he demands this service immediately—especially if the temperature outside is zero or below. By stocking a good supply of spare parts and extra resistance heating units and following a conscientious policy of prompt repair calls, an electrical contractor can build a solid reputation for service which will put him in good stead with both his old customers and with new prospects. An electrical contractor should stand behind the workmanship of all his jobs and willingly repair or replace any faulty equipment which he installs.

In conclusion, it may be stated that the electrical contractor can do much, not only to remain competitive in the electric home heating field, but to reassert and expand his role as its most effective and successful promotor. He has the greatest personal stake in developing this market. Electric home heating is his life blood—it is the key that opens the door to "all-electric living," with all the comfort and convenience it affords.

Humidity and Condensation—IV

Use of vapor barriers to avoid moisture damage in the electrically heated house.

By W. J. Novak

THE most practical structural means of reducing the transmission of water vapor from a heated space to wall cavities, attics and crawl spaces is to provide an interior surface which is relatively impermeable to water vapor. This may be done through the use of *vapor barriers.*

Low permeability means high resistance to water vapor. Materials with such properties, in decreasing the amount of transmitted vapor, also lower the relative humidity and dew-point temperature within a wall cavity, further reducing the probability of condensation.

The provision of vapor barriers is frequently within the province of the heating contractor or engineer; hence, a working familiarity with their characteristics, capabilities and proper installation is effective insurance against moisture troubles.

What is a vapor barrier? The principal property of a vapor barrier distinguishing it from similar materials is its ability to restrict the passage of water vapor through it to an acceptable rate.

In new home construction, vapor barriers most frequently encountered are asphalt-saturated kraft paper or reflective foil covering one face of mineral wool and wood fiber insulating batts and blankets, and large thin sheets of polyethylene film fastened across the interior face of studs and joists before installation of interior walls, floors and ceilings or laid over the bare earth in crawl spaces. Another very effective barrier for protection against ground moisture is weathercoated asphalt board lined on both sides with asphalt-impregnated kraft paper. Roll roofing (55 lb or more per 100 sq ft) is also commonly used as a ground cover. Adjacent layers are overlapped at least 2 in. and normally require no fastening or cementing. Building paper, sheathing paper, and tar and asphalt felt are unsuitable for the purpose, since they pass vapor too readily. A concrete slab over the ground in itself is not effective unless a barrier is used beneath it.

Other materials in use include various duplex or laminated products, consisting of two sheets of kraft paper with a layer of asphalt between them; aluminum foil or foil-backed paper; various corkboards; and asphalt-coated, asphalt-impregnated, and painted gypsum board and plywood.

In existing structures, smooth plaster and gypsum board may be painted to provide a suitable barrier to vapor. This is frequently necessary where old houses are insulated by blowing insulation into the walls from outside upon conversion to electric heat. While loose construction common in older buildings might keep humidity levels below the danger point, the addition of insulation is usually accompanied, and correctly so, by a general weatherproofing of doors and windows. This, plus the possibility of the homeowner later adding some humidifying equipment, makes it inadvisable to depend upon natural infiltration to prevent moisture penetration.

The most effective paint job is done by one or two coats of aluminum primer plus two finish coats of lead and oil or flat paint of the desired color. The prime coats are necessary to prevent the finish coats from being absorbed by the surface and thereby producing a non-uniform coating. Rubber-base paints and paints with high varnish content afford good protection when applied in a continuous, unbroken coating; water emulsion paints and those using linseed oil as a base do not. To assure a lasting barrier, the surfaces should perhaps be repainted more frequently than would otherwise be necessary.

The same painting procedure should be followed for ceilings and interior partitions. Water vapor

Understanding the Perm

The *perm* is a unit of measure devised to designate *permeance,* the rate at which a material permits water vapor to pass through it.

1 perm = 1 grain of water vapor per hr per sq ft of area per in. mercury pressure difference at standard test conditions.

A *grain* is a unit used to designate the weight of water vapor in very small quantities:

1 lb = 7000 grains.

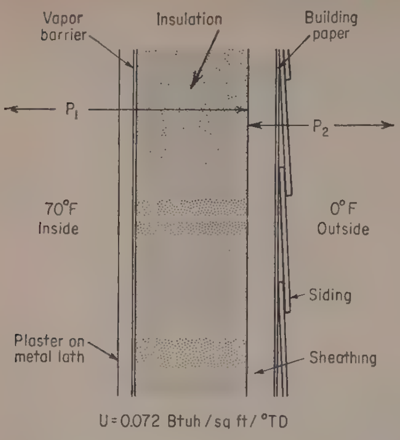
Atmospheric pressure may be given either in lb per sq in. or inches of mercury. The former indicates the weight of a 1-sq-in. column of air extending from sea level to the extreme upper limit of the earth's atmosphere. The latter indicates the height to which a column of mercury within a tube will be raised by the pressure of atmospheric air acting on a pool of mercury feeding the tube.

Standard atmospheric pressure (at sea level at 32F)
= 14.696 lb per sq in.
= 29.921 in. mercury

These two units of measure may be converted one to the other:
lb per sq in. x 0.491 = in. mercury
in. mercury x 2.036 = lb per sq in.

That portion of the atmospheric pressure due to the water vapor existing in the air may be determined for various conditions of temperature and humidity, both inside and outside a structural component (wall, ceiling, etc.). The difference between these two values is the "pressure difference" referred to in the definition of the *perm.*

Effect of Inside Relative Humidity on Vapor Pressures in Insulated Wall*



Inside RH	P_1	P_2
20	1.7	1
30	3.3	1
40	4.9	1
50	6.4	1
60	8.0	1

* See "Condensation Control in Buildings," by C. E. Lund, *Heating and Ventilating*, August, 1952.

For a given constant vapor pressure difference P_2 across the "cold" face of the wall, the pressure difference P_1 across the "warm" side increases greatly as the inside relative humidity increases. Assuming unity for P_2 for purposes of comparison, the vapor pressure difference at 40% RH, for example, tending to force vapor into the wall is shown to be about 5 times that tending to remove it to the outside. To promote the constant removal of vapor inside the wall, therefore, the *vapor resistances* of the vapor barrier and building paper should be roughly in the proportion of 5 to 1, respectively. This makes it 5 times as hard for the vapor to get into the wall as it is to get out. Stated another way, the *permeance* of the building paper should be about 5 times that of the vapor barrier.

If average humidities of 30% to 50% are accepted as desirable, the above table is one method of demonstrating a reason for recommending a 5-to7-perm rating for the building paper with a 1-perm vapor barrier.

entering the partitions near the points of intersection with the outside wall or ceiling will migrate toward the outside, and condensation is possible.

Alternative wall finishes providing reasonable protection in existing houses are wall linoleums and some wallpapers using a coated cloth as a base.

How is the performance of a vapor barrier measured? Resistance of various materials to the flow of vapor through them has been discussed. The reciprocal of such resistance is known as *permeance.* Thus permeance designates the ability of a material to permit the passage of vapor through it. From the standpoint of a vapor barrier, the lower the permeance the better the barrier. Permeance is stated numerically in *perms* (see box).

Perm ratings have practical significance in designating the results of tests determining the effectiveness of vapor barrier products. Several independent investigations of perm ratings of various materials have been made and reported, with varying results. Consequently, comparisons between products should be made using the results of a single investigator obtained under identical test conditions. Additional caution is necessary in applying such test results to a specific material; the same material made by different manufacturers may vary considerably in perm ratings. A material specifically intended as a vapor barrier should be designated as such in the manufacturer's specifications, including the perm rating as established by a recognized testing laboratory under stated test conditions.

Current testing methods used follow standards as set up by the American Society for Testing Materials. In general, two types of tests are used, which may be simply termed as the "wet" test and the "dry" test. The wet test gives higher perm values than the dry test; hence, it is necessary when comparing ratings that they have been obtained using the same type of test.

Caution should also be observed in comparing permeability expressed in terms other than perms; some data are based on "lb per sq in." pressure rather than "inches of mercury."

Of what practical use are perm ratings? From the installer's point of view, there are two important considerations in providing materials for moisture control. It has been established that, for the vapor pressures encountered in the average electrically heated house, (1) the vapor barrier shall have a rating of not more than 1 perm; and (2) the material selected and installed for weatherproofing the outside of the structure shall have a rating of 5 to 7 perms. (These ratings are based on the "dry" test.) The former is a vapor barrier; the latter is not and must not be. It must be capable of minimizing the amount of moisture entering the structure through the exterior surface by action of the wind, rain, and snow. Yet it must be sufficiently permeable to moisture to permit any accumulation within the structural cavities (whether as a result of penetration from inside or outside) to evaporate readily to the outside. Such materials may be referred to as "breathers." A completely enclosed batt of insulation, for example, uses a vapor barrier material on one face and a breather paper on the sides and back face. Sheathing papers and building papers used between the sheathing and siding are other examples.

Since even individual samples of one manufacturer's product vary in permeability, it is well to select materials rated at 0.5 to 0.6 perm to be sure that all material used will fall below the recommended 1 perm maximum.

Better-than-1-perm performance is required of the vapor barrier under certain conditions, such as in structures where metallic external building materials are used. These materials are unable to "soak up" or hold water vapor passing through from the interior until it can be passed to the outside, hence condensation is more likely. It is evident that under such conditions every effort must be made to keep the passage of vapor through the interior building materials to an absolute minimum. However, this does not mean that as a result lower perm ratings for the exterior "breather" materials are permissible. They still must be capable of allowing the evaporation and expulsion of moisture entering from the outside.

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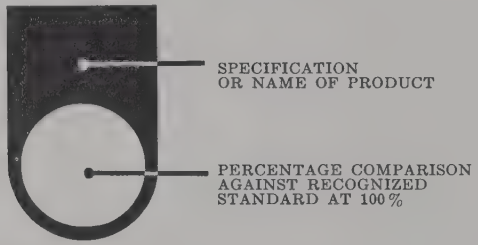
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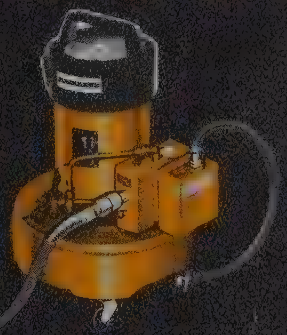

Yes, Blackhawk Industrial Products Co. has a new color scheme to go with its new name. Products are now distinctively painted yellow and charcoal. This styling tells you the product is designed for industry, to fill a specific need.

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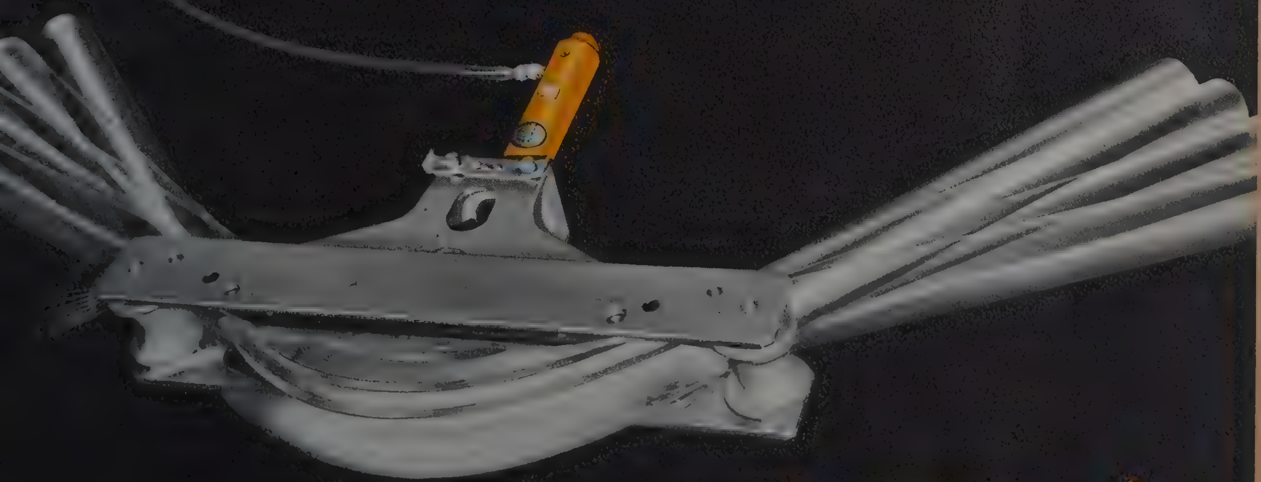

See other side . . . ▷

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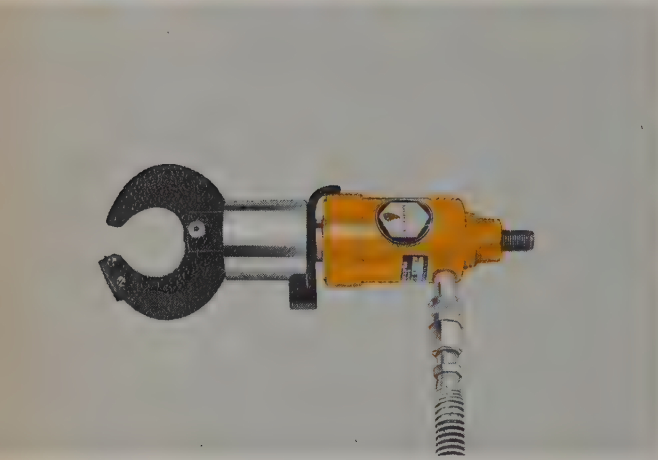

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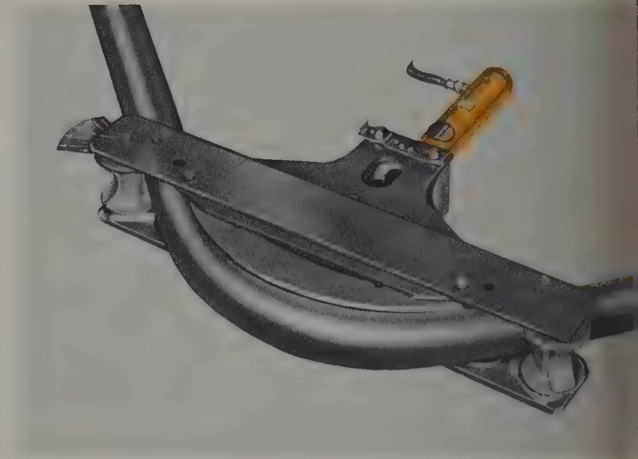

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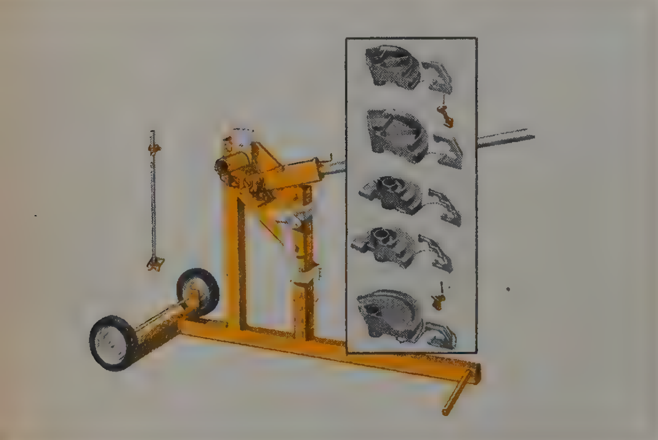

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Giant Winch Strings Transmission Lines

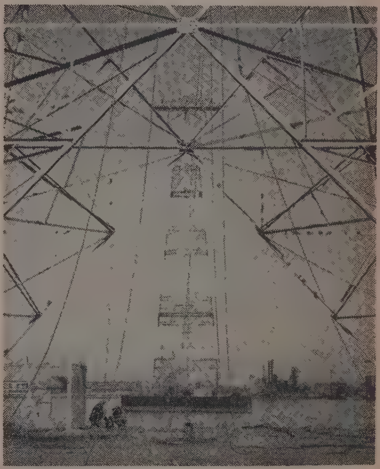
Teamwork among installing personnel and careful control in the use of power stringing equipment made possible this river crossing of a transmission line.

TEAMWORK played a big part in solving a highly complex construction problem faced by the Philadelphia Electric Company. To provide an outlet for the power generated at the Company's new Eddystone station and to insure adequate power to Philadelphia's rapidly growing Northeast area, the Company has built a new 22-kv power line across one of the nation's most heavily traveled air and sea approaches, the Delaware River. Day and Zimmerman was the electrical contractor for tower erection and wire stringing.

The new line is the latest link in the ever-increasing network of power lines comprising the Pennsylvania-Maryland-New Jersey Interconnection. Crossing the Delaware River at Marcus Hook the line connects Philadelphia Electric Company's Chichester substation with the Gloucester, N. J., substation of Public Service Electric and Gas Company and the Mickleton substation of the Atlantic City Electric Company.

Because of the complexity of the river crossing, Philadephia Electric designed the river towers and islands on which the towers were constructed. Regulations covering river traffic required that the cable have a minimum clearance of 210 ft above the ship channel. Since the crossing is in the path of planes approaching nearby Philadelphia International Airport, the towers had a limit of 350 ft. Engineers of both companies were finally able to work out a design which would meet the requirements imposed by river and air traffic. Both sets of regulations were satisfied. The final height of the towers was 348 ft.

Another example of teamwork in the project was the detailed work involved in the actual stringing of the wire. The Braden Winch Division of Nautec Corporation, provided the contractors, Day and Zimmerman, with a constant-load winch and two auxiliary winches which were located on the man-made islands supporting the towers. Braden personnel were present in an advisory capacity. Because of the clearance and height limitations, only 110 ft of sag in the conductors was permitted. This required cooperation between Philadelphia Electric and the conductor manufacturer to develop special conductors and ground wires for the high tensions involved. For reasons of reliability of service and ease of maintenance, each span of wire was a separate piece, cut to the proper length and the dead-ends installed prior to stringing. The three



SUPPORTING TOWER for river-crossing of transmission line is installed on a man-made island in the river.

GIANT WINCH was used by the electrical contractor to pull transmission lines, on towers, across the Delaware River.

LEVITON QUALITY *talks...*

"You're right in figuring Leviton on this bid!...

"Darn right! I've been very happy with Leviton on the last two jobs. And this may mean the third."

This typical wholesaler-contractor conversation at bid time is being repeated 'round the country. Leviton's line of specification grade devices have caught on.

Everyone is pushing Leviton because of the delivery, the price, the completeness of line and the consistent quality. Architects and engineers have the confidence to specify Leviton on their biggest projects.

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Quiet Switch in 15A.-120-277V.A.C. only and 20A.-120-277V.A.C. only

HIGH CAPACITY will accommodate the high inductive loads of fluorescent systems, or full rated capacity of tungsten filament lamp loads. Take full load currents up to 80% of the switch rating for motor control.

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TALKS BUSINESS

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LEVITON MANUFACTURING CO., INC.,
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Contact American Insulated Wire Corp., Pawtucket, Rhode Island, a Leviton subsidiary, for a complete line of insulated wire and cable products.

EXACT CONTROL of the cable stringing operation is provided by the power winch, on which the operator can switch gears to advance or retract the line for exactly an inch a mile away, if necessary.

spans were then connected together with appropriate hardware, capable of withstanding a load of 50 tons, and pulled in as a single piece. As these hardware sections had to be transferred through the towers by shifting hoists and pulleys, very close control of the cable movement was necessary.

During the stringing operation itself, the wires were permitted to come down to 150 ft above the channel. Whenever a ship approached, however, it was necessary to raise the wire to clear the water by at least 200 ft. This was done smoothly and effortlessly by the constant-load winch.

The winch is equipped with a 3-speed transmission that will allow a cable pull of 30,000 lbs at 40 fpm, 17,000 lbs at 70 fpm and 8,000 lbs at 140 fpm. An additional reverse speed is available allowing the cable to be paid out at 310 fpm or about 3½ miles per hour. Flow control valves in the hydraulic drive system give infinitely variable cable speed control in both forward and reverse from 0 to maximum speed.

A direct-reading cable load gage shows the operator the exact cable load at all times. An additional indicating hand on the gage can be present for any desired maximum pull from 0 to 30,000 lbs. When the cable load increases to the present maximum, the winch operation will automatically stop. An oil cooling system allows the winch to be run continuously at any speed or load.

The electrical contractor's success in stringing the lines can be attributed directly to the winch.

ADVANCE®

The only complete line of fluorescent lamp ballasts

ADVANCE Improved **SOLID-FIL** Ballasts incorporate **DRIP-FREE UNITIZED CONSTRUCTION**, dissipate heat faster and offer greater safety. The new ADVANCE **SOLID-FIL** development provides quieter operation than other solid fill materials.

Through outstanding engineering developments and modern manufacturing facilities, ADVANCE TRANSFORMER COMPANY has become the world's largest manufacturer devoted exclusively to the production of quality fluorescent lamp ballasts. These precision built, power regulating instruments supply exacting amounts of electrical energy for the efficient operation of all fluorescent lamps and are aptly called "THE HEART OF THE LIGHTING INDUSTRY."®

Continuing research and constant new developments in both engineering and manufacturing divisions have made possible the introduction of many new ballasts with exclusive patented features. Thus, ADVANCE provides lighting equipment manufacturers, designers, architects, engineers, contractors and other fluorescent lamp ballast users the world's most extensive line of fluorescent lamp ballasts. When you use ADVANCE, there is a ballast for every specific purpose, never a need to compromise.

Kool Koil Fluorescent Lamp Ballasts provide up to 15% more light output, operate 15° to 20° cooler, increase ballast life 3½ to 4 times.

ADVAN guard

ADVAN-guard equipped Ballasts are thermally protected to safeguard against failure from excessive temperatures, excessive current, excessive voltage and end-of-life hazards.

A SOUND RATED

Advance "A" Quiet-Rated Ballasts utilize a special thermo-pliable compound that absorbs the vibration of core and coil before it becomes sound.

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★ Lightweight
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★ Easy to Handle
★ Easy to Bend
★ Less Voltage Drop
★ Locally Stocked

For complete information and names of Reynolds Aluminum Rigid Conduit Distributors, call your Reynolds Sales Office, or write: *Reynolds Metals Company, Box 2346-ET, Richmond 18, Virginia.*

Certified Audits Prove Benefits of 200-FC Lighting Installation

A very tangible testimonial to the economic benefit of good lighting is provided by three certified audits submitted to us by the Metwood Manufacturing Corporation of Gardena, Calif.

Several years ago this company purchased an old plant and spent considerable money remodeling and modernizing it, purchasing new equipment and devising a machine layout which would promote maximum shop efficiency, lessen materials handling and improve the logical flow of work in progress.

When these steps had been completed, however, money available for relighting the plant was on the scanty side. So, since lighting was considered to be "a hypothetically desirable but intangible asset that couldn't be evaluated," the existing lighting system (consisting of standard 2-lamp 4-ft fluorescent industrial fixtures placed functionally above the various machines) was left "as is."

During the next year the volume of orders received by the company was gratifyingly increased, although it was disturbing to note that product rejects were high, personnel efficiency was disappointing, accidents resulting in lost time were prevalent and employee turnover was sizable. Since employing and training new workers was time-consuming and costly, the management finally called upon a G. E. industrial consultant for a solution.

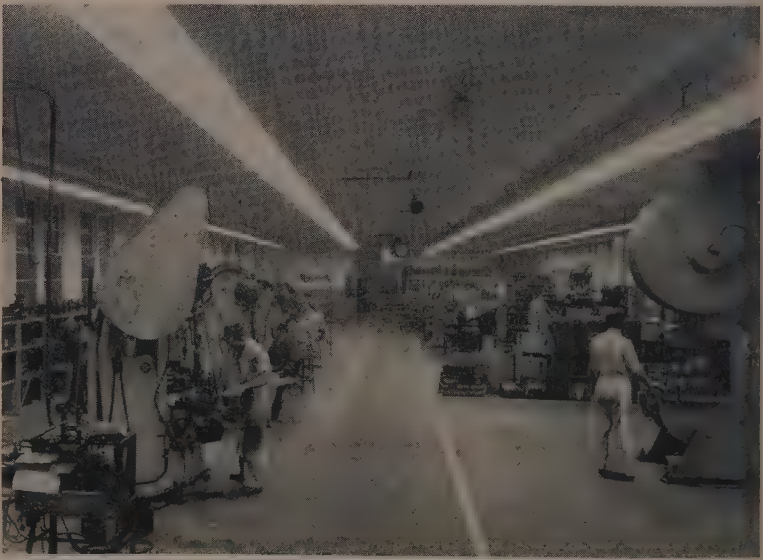
Among other things, the consultant recommended installing a new 400-amp electrical service and a 4-lamp slotted-reflector continuous-row lighting installation which would provide lighting intensities on working surfaces in the order of 200 footcandles. This recommendation was followed.

Still skeptical concerning tangible benefits, however, Metwood officials decided upon two independent 20-day audits of production; one audit to be taken a month before the new lighting system was installed and the second audit to be conducted two months later. Comparing these before-and-after audits indicated an improvement of 16% in machine-time efficiency and a reduction of 26% in rejects and reworks.

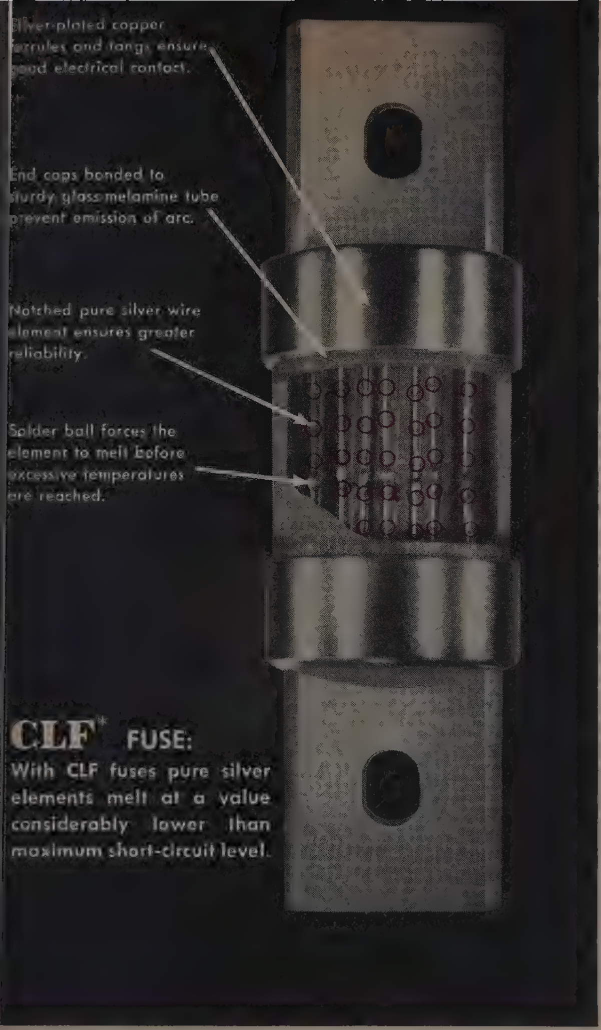
As an additional check, a third 20-day audit was made a year later. This showed that machine-time efficiency was still up 16% from pre-lighting levels, rejects and reworks had been reduced an additional 6%, lost-time accidents had dropped 52% and employee turnover had decreased 58%.

These percentages represent sizable returns, for close tolerances are critical in this machine tool, die and punch-press shop area, and production is continuous on a 3-shift basis.

As a more specific example of operating charges, one single milling machine, costing $13,750, has a related machine-time charge of $6



CONTINUOUS ROWS of 4-lamp slotted-reflector industrial fluorescent fixtures provide 200-fc lighting level to critical-seeing areas in this machine shop. Lamp outage at end of 2-year period was zero, although complete replacement was approved at that time. Ballast failures were also zero.


Silver-plated copper ferrules and tangs ensure good electrical contact.
End caps bonded to sturdy glass-melamine tube prevent emission of arc.
Notched pure silver wire element ensures greater reliability.
Solder ball forces the element to melt before excessive temperatures are reached.

CLF* FUSE: With CLF fuses pure silver elements melt at a value considerably lower than maximum short-circuit level.

CONVENTIONAL: With conventional fuses, short-circuit currents are allowed to build up with explosive consequences.

Cutaways of General Electric CLF fuse and conventional fuse illustrate superior quality, reliability, and protection found in G.E.'s Class J current limiting fuse.

PERFORMANCE you can see!

The performance of the fuse protecting your electrical equipment can mean the difference between a severe short-circuit explosion at the fusing point, or reliable current limiting protection.

The moment a short-circuit starts a current surge build-up in your power distribution system, General Electric's new CLF fuse begins its work. Pure silver elements of the CLF fuse melt at a value considerably below the maximum short-circuit current available to enter the fuse box.

Small, momentary current surges which don't actually *melt* a fuse don't *weaken* the CLF fuse's characteristics . . . CLF fuses end nuisance blowing forever.

You *know* you can always rely on the quality, protection and reliable performance of General Electric CLF fuses.

*CLF is the trademark of the General Electric Co. for high interrupting capacity fuse which meets new NEMA standards FU 1-1959.

Elements in many conventional fuses, however, may allow the short-circuit level to build to a damaging explosion point. With today's costly equipment, conventional fusing is a risk you can't afford. Specify CLF fuses for quality, reliability . . . specify performance you can see! For further information, write Section 618-02, General Electric Co., Schenectady 5, N. Y.

40,000 amp current surge touches off powerful explosion in conventional fuses.

Progress Is Our Most Important Product

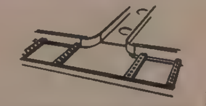
GENERAL ELECTRIC

CABLES COULDN'T BE EASIER TO INSTALL...

Start with rugged system supports, wall-mounted or suspended from the ceiling in minutes. Then join lightweight system components quickly with just a coupler plate and two steel pins. Add sections, change direction, elevation, or width as required—Cope Wireway makes the toughest jobs easy. To pull the cables? Just lay them in the trough. One section of 24″ Wireway supports as many cables as fourteen lengths of 4″ conduit—ample capacity to handle the heaviest distribution loads.

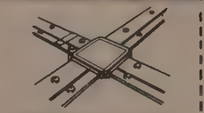
Easy to work with, easy to get at, Cope Wireway makes every installation simpler, faster. Ask a Cope man about the complete line of Cope cable supporting systems—or write direct for detailed data. SOLD ONLY THROUGH AUTHORIZED ELECTRICAL WHOLESALERS.

COPE WIREWAY



LADDER AND CHANNEL

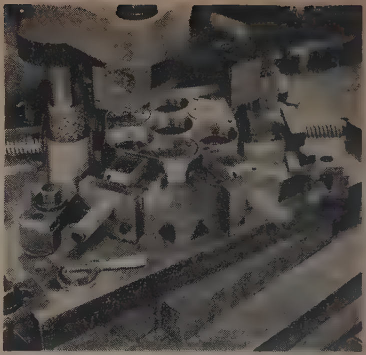
SYSTEM SUPPORTS



UNDERFLOOR DUCT

TJ COPE DIVISION ROME CABLE CORPORATION
Collegeville, Pennsylvania Dept. G

A CHOICE OF WIRE AND CABLE SUPPORTING SYSTEMS



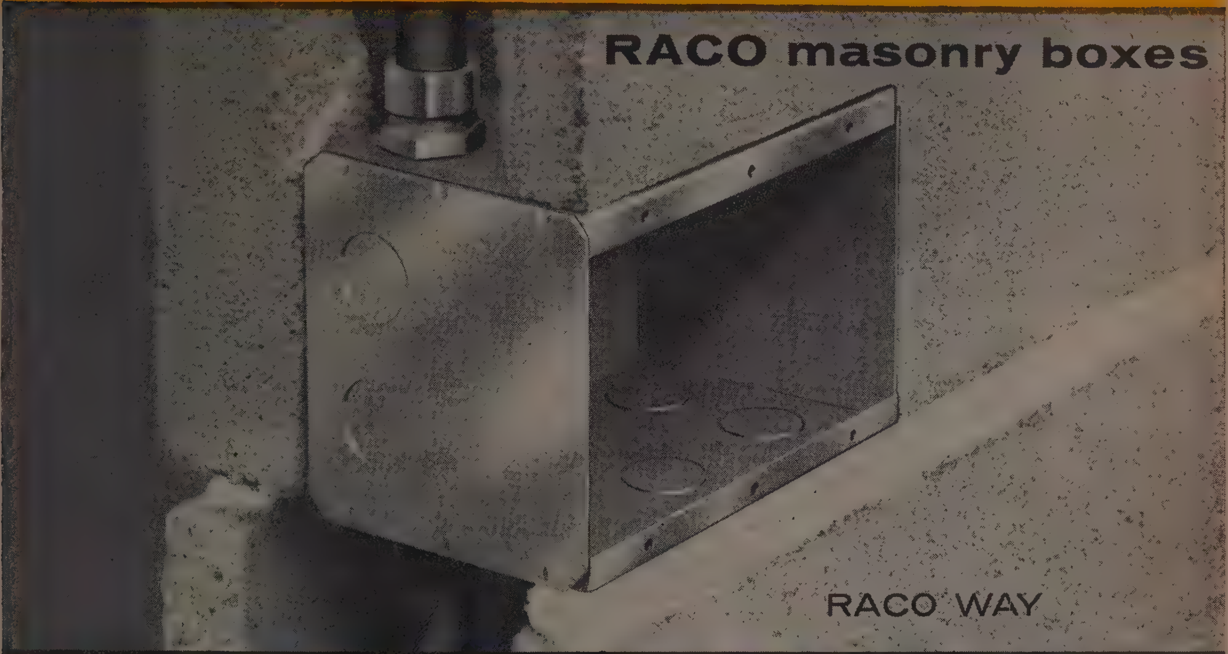
PROVISION OF 200 FOOTCANDLES on critical-tolerance working planes resulted in improving machine-time efficiency 16%, reducing rejects by 32%, reducing lost-time accidents 52% and cutting personnel turn-over by 58%. Complete cost of operating lighting system, including power, taxes, depreciation, maintenance and relamping, is 54 cents an hour.

per hours; i.e., $48 per 8-hour shift or $144 per day. With one operator, the related labor cost is approximately $60 a day and gross earnings for the manned machine, prior to relighting, was slightly over $84 a day. By comparison, the new service entrance, wiring and lighting system cost a little more than $10,000, while the cost of operating the system (including power, taxes, depreciation, washing the fixtures every 12 months and group-relamping every two years) is estimated at 54 cents per hour. And, incidentally, both lamp and ballast mortality during the first 2-year period was zero.

From a skeptical beginning, the management now endorses good lighting enthusiastically and, according to Metwood's secretary-treasurer R. J. Schoen, "We are now convinced that good lighting is as much a production tool as any piece of equipment we own. In fact, it contributes more to over-all reduction of operating costs than any other expenditure we have made. On the basis of our shop experience, we have since extended these 200-fc lighting levels to our offices, and results there have been equally effective. In considering total expenditures for the improvement, we related lighting charges to cost of operational equipment, direct operating costs to total payroll, and over-all efficiencies to product output and personnel turnover. In each instance we concluded that the relighting program had justified itself many times over, and we welcome this privilege to endorse good illumination."

Such a testimonial proves that good lighting pays off.

RACO HELPS YOU...
do a better job... save time and money



Raco masonry boxes have a "sheer" rectangular design saving installation time—no ears to cut around.

Raco boxes are deep—conduit fits the voids of the block perfectly. Device holes are on the inside of Raco boxes—eliminating re-tapping and reducing "mudding around".

Available in 2, 3, or 4 gang boxes; 2½" or 3½" depths with ½" or ¾" knockouts. Whatever the job, Raco has a time-saving masonry box to fit the need.

RACO MASONRY Thru-the-wall Boxes

Raco masonry thru-the-wall boxes replace two boxes, one fitting and two plaster covers—you save money, material and labor. Square cornered Raco boxes require less "mudding" and less time to install. Available in three sizes—for use with 4", 6" or 8" cement blocks. You save time and money, do a better job, with Raco masonry through-the-wall boxes.

Send for the Raco masonry box brochure today.

RACO

ALL-STEEL EQUIPMENT INC., Aurora, Illinois

Heavy-duty extensions...

Cornish, of course

In the shop or in the field—count on Cornish to furnish everything you need in heavy-duty extensions. You'll find Cornish heavy-duty cords with ratings to 600 volts, 10 amperes...lengths to 100 feet...molded-on connectors. Twistlock connectors give fast, safe, positive connection—can't be disconnected by accident. ◆ Need extra field outlets? Use Cornish "Y" and "W" junctions. Field lighting? String it in a flash with Cornish Lite-Line. ◆ Remember Cornish, too, for the only really complete lines of electronic wires, flexible cords and thermostat wires. ◆ For plug-in power—anywhere—call Cornish. Distributors are everywhere—coast to coast. Cornish Wire Co., 50 Church Street, New York 7, New York

CORNISH

Shop Efficiency Backed By Modern Equipment

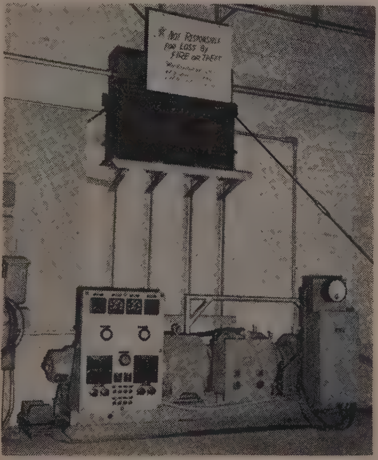
AN UNUSUALLY well-equipped, clean, efficient repair shop is to be found in Oakland, Calif., where Benkiser Electric Motors is located. This favorable impression is obtained promptly upon entering the shipping dock, for there one sees a modern service-entrance panelboard; an overhead bank of dry-type transformers for converting incoming utility 115/230-volt power to 440-volt service required for ac test purposes and for operating an electric baking oven; and a motor-generator assembly that can connect two generators either in series or parallel to supply 115 or 230 volts, dc, for testing a considerable amount of marine equipment serviced in this shop.

Adjacent to the service entrance, a dynamometer is available to check all nameplate data of motors under actual full-load and overload conditions prior to placement of guarantees on units and their return to customers. At this stand, motors rated 3 hp or less, ac or dc, single or 3 phase may be measured for speed, torque, amps and volts. Linkage between motor being tested and dynamometer is established through a universal joint connection chuck.

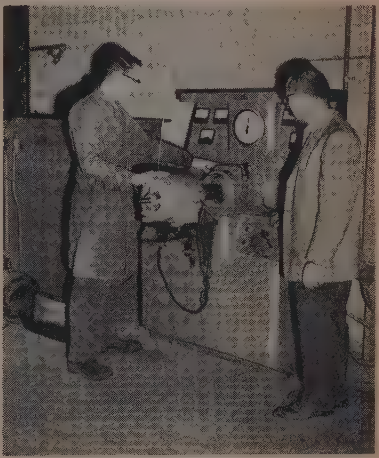
The electric oven referred to above is a 25-kw, 440-volt, 3-phase unit capable of maintaining temperatures up to 600 degrees F. Such temperatures are controlled by thermostat and clock mechanisms for desired baking periods. As noted in an accompanying photo, radiant strips are bolted to interior side panels, while side curtain walls are also provided to direct hot air downward, after which it circulates upward past equipment being baked, and then out through an overhead motorized exhaust port.

In the same picture, in the right background, a technician may be noticed lowering a newly wound stator into a dip tank, using a jib boom and rolling hoist unit for this purpose. This materials-handling medium typifies similar shop-wide lifting facilities, for the shop in its entirety is served by seven hoist rigs, the largest being a 5-ton bridge crane spanning the main receiving and shipping bay.

Still another indication of modern equipment in this shop is the machine section, where a lathe can handle assemblies up to 34 in. in diameter and 9 ft in length, and where metal spraying can build up



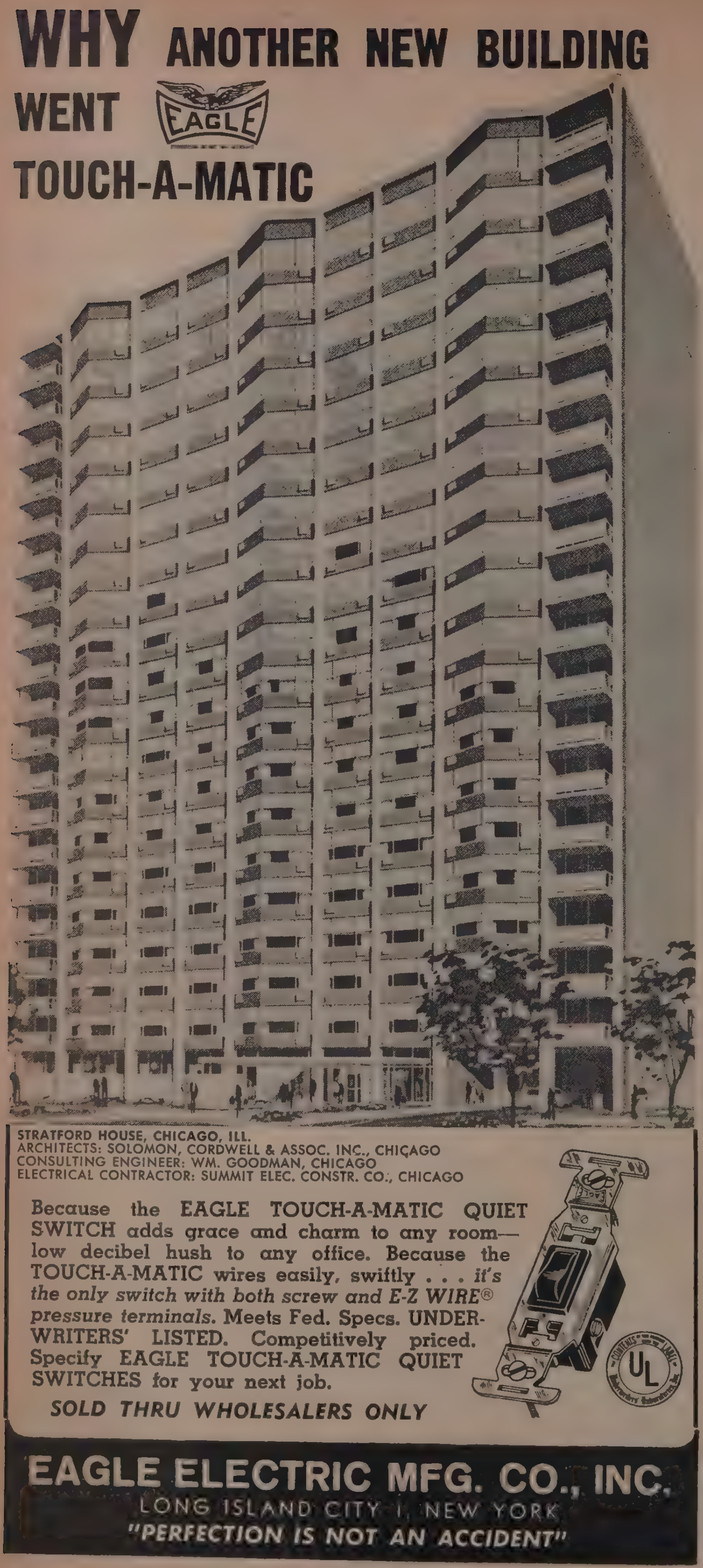
POWER CENTER in modern shop includes incoming utility service entrance, elevated bank of dry transformers for stepping initial current to 440 volts for bake oven and testing purposes. Generators can be connected in series or parallel.



DYNAMOMETER test stand checks operating characteristics of all motors sized 3 hp or less designed for either ac or dc single or 3-phase. Here shopowner Henry Benkiser (right) gives nod of approval to operator Ken DeHaven.

ELECTRIC OVEN with rating of 25 kw at 440 volts has heavily insulated bi-parting doors, horizontally mounted radiant strip heating units, curtain walls and exhaust system to direct hot air first down then up through components.

LATHE with 9-ft reach and 34-in. permissible span is used in this instance to support damaged shaft while worn spots are built up by metalizing. After metal is built up above desired thickness, shaft will be turned down to precise diameter.



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WENT EAGLE
TOUCH-A-MATIC

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CONSULTING ENGINEER: WM. GOODMAN, CHICAGO
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Because the EAGLE TOUCH-A-MATIC QUIET SWITCH adds grace and charm to any room—low decibel hush to any office. Because the TOUCH-A-MATIC wires easily, swiftly . . . *it's the only switch with both screw and E-Z WIRE® pressure terminals.* Meets Fed. Specs. UNDERWRITERS' LISTED. Competitively priced. Specify EAGLE TOUCH-A-MATIC QUIET SWITCHES for your next job.

SOLD THRU WHOLESALERS ONLY

EAGLE ELECTRIC MFG. CO., INC.
LONG ISLAND CITY 1, NEW YORK
"PERFECTION IS NOT AN ACCIDENT"

worn surfaces and shafts, thereby restoring years of useful life and eliminating costly replacement of components. In this salvage operation, a worn or scored shaft is first undercut, then roughed to provide a firm bonding surface for metal spray which is built up above the desired finished diameter. This built-up shaft is then machined down to precise dimensions. This restoration technique has numerous applications, inasmuch as spray guns can project metalized aluminum, babbitt, brass, bronze, copper, iron, lead, monel, nickel, steel and stainless steel, tin, zinc or special alloys.

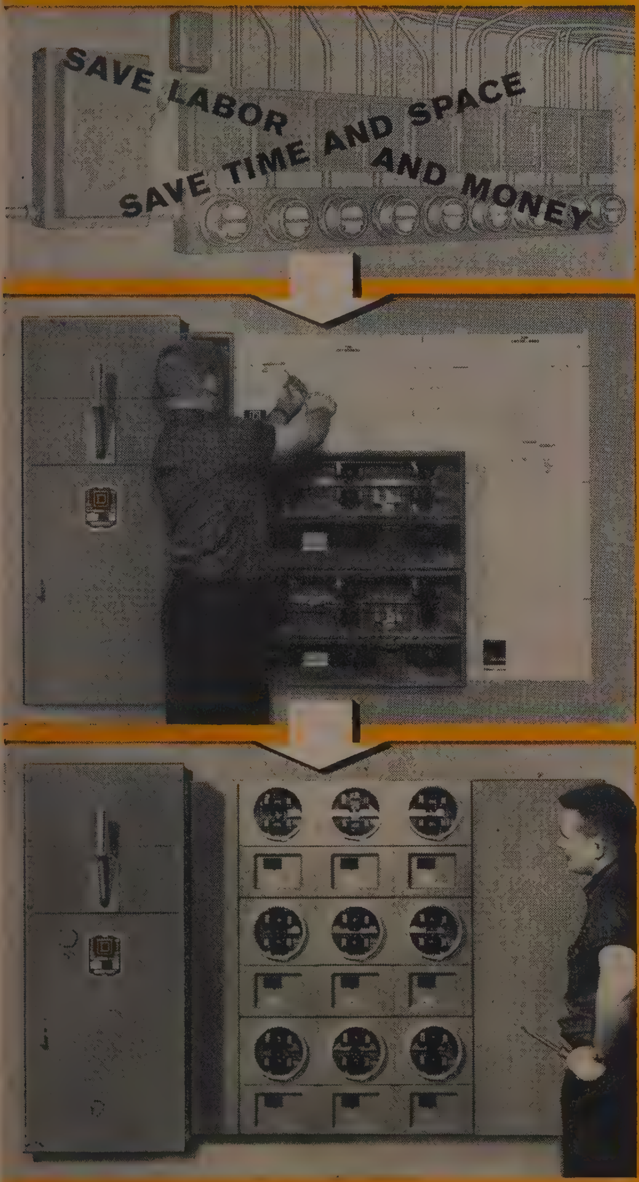
Barber-Chair Pedestal Workbench is Completely Adjustable

The pedestal of a discarded barber chair plays a frequent and practical role in the shop of Lindstrom, Inc., San Francisco, because raising, lowering and rotating features of this assembly make it ideal as the base for a fully adjustable workbench. Work surface consists of a 3-ft disc of $\frac{1}{2}$-in. steel plate welded to a pedestal collar. And, should it be desirable to cover this deck with an insulated or slipproof material, either leather belting or rubber sheeting may be utilized for this purpose. Since height of table is readily adjustable by manually applied pumping action and may be rotated freely, then locked securely in any desired, fixed position, this "discarded" item has obtained a prolonged span of useful service.

STURDY STEEL TABLETOP supported by old barber-chair pedestal makes practical workbench, since height is readily adjustable by hand-lever pump action, and surface may be rotated or locked in fixed position as desired.

Simpler Installations with E-Z STACK MULTIPLE METERING PANELS*

*Underwriters' Laboratories Approved



Easy as hanging a picture—and it's stocked by your Square D distributor

Plan your own arrangement • Wall space for the grouping and service of meters is often limited. Locations of service and load conduits vary. With E-Z STACK you have freedom of arrangement.

Simple installation • E-Z STACK devices include full size template and wall mounting hanger brackets. Templates, attached to wall, accurately position hanger brackets for each device. Brackets on wall interlock with clips on back of device.

One-man assembly • Unit assemblies permit easier handling of all components. Wall brackets support each unit in its proper place while entire installation is being inter-connected and secured.

Availability • E-Z STACK devices can be ordered from Square D Distributors as they are needed. Individually cartoned, the final decisions on meter arrangement and size of the circuit breaker disconnect for each apartment can be made at the Distributor's counter.

ALSO AVAILABLE IN RAINTIGHT ENCLOSURE

Write for literature—Square D Company, Mercer Road, Lexington, Kentucky

D

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wherever electricity is distributed and controlled

Rugged Design...
Easy-to-Handle Balance

RIDGID®
HEAVY-DUTY
PIPE
CUTTERS

give faster, straighter cuts

Five Sizes
for ⅛″ to 6″

FACTORY TESTED

Pick up a RIDGID Heavy-Duty Pipe Cutter, and you'll instantly know why it makes pipe and conduit cutting far easier. Perfectly balanced . . . gives you a feel of confidence no other cutter can match. See the extra-long shank that protects handle threads . . . assures easy pressure application. Feel the large, smooth handle that gives you a comfortable, powerful grip. Try it, and you'll find a built-in cushion to keep the cutter wheel "on track" through hard or uneven spots. Rugged frame, guaranteed not to break or warp, stays straight for clean cuts every time.

You'll Want a RIDGID 4-Wheel
Pipe Cutter for Work in Tight Places!

Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and Parts!

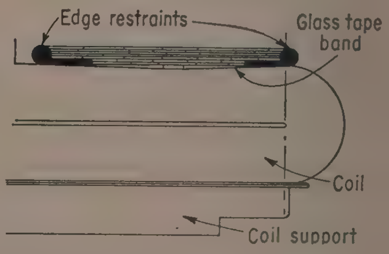
RIDGID®
The Ridge Tool Company, Elyria, Ohio, U.S.A.

Glass Banding Armatures With Turn-Around Knuckles

Application of high-tensile glass banding tape to traction armatures with turn-around knuckles (such as the G.E. No. 752 and West No. 370) requires special consideration particularly when banding the pinion end. Not only is total amount of banding tape important, but attention must be directed to proper amount and build-up of tape at the right points or areas.

Because all armature coils can (and do) reach elevated temperatures in service, restraint of a hot coil must be considered. Slot wedges hold the coil well in the core. The band must hold coil sections extending beyond the core. The greater the distance away from the core and the hotter the operating temperature, the more important it is that an adequate amount of glass banding tape be placed all the way out on the coil—to and including the top of the turn-around. If the band is permitted to feather out to a thin cross-section, or if full thickness is not applied at the point of coil turn-around, armature coils are apt to raise or "blossom" during motor operation. Under these conditions they may hit the field coils and "tear up" the motor.

To do a good banding job, the high-tensile glass fibers of the tape must be allowed to nest themselves with respect to each other and should not be artificially held by cross members, according to engineers of the industrial tape division, Chicago Printed String Co., manufacturers of Res-i-glas banding tape. Recognizing that it is difficult to wind layers of glass banding tape (non-woven parallel glass fibers bonded with resin) upon themselves without some slipping out under layers, CPS engineers recommend a number of edge-



EDGE WELT restraints assure full thickness of glass banding tape at edges of armature band, particularly at coil knuckle. Welt is plain or impregnated glass cloth wrapped around a glass or asbestos cord.

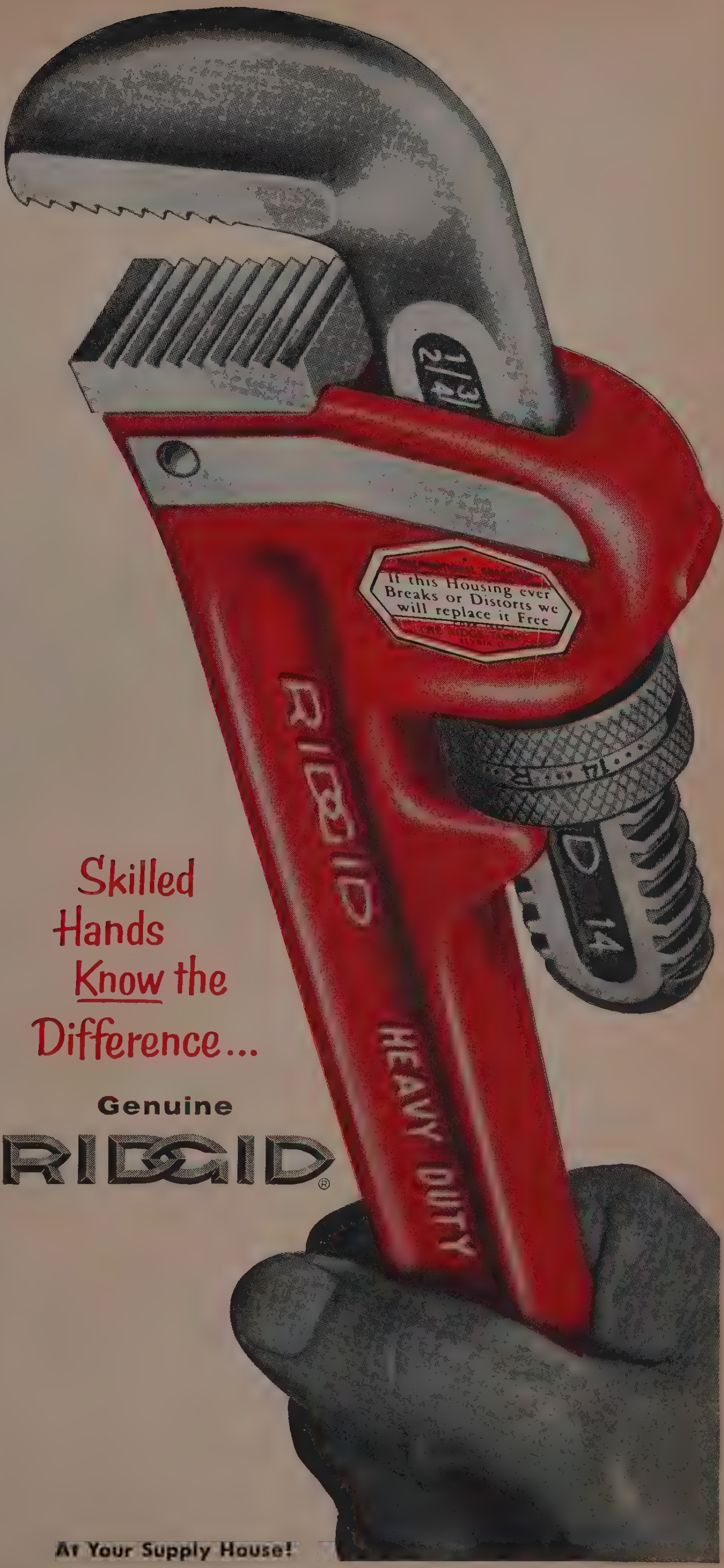
restraint techniques. Among them are the following:

Welting—This method involves the use of "welts" composed of either an impregnated or plain glass cloth 2½ in. wide (or wider) wrapped around a glass or asbestos cord about 3/16 in. or ¼ in. diameter. This welting is then placed on the coils (see illustration) or on the first layer of banding tape. As banding continues, additional layers of tape are payed against the welt. During cure (baking), this welt will remain in place on the hot-banded piece and will slide out about ⅛ in. on the cold-banded unit.

Steel Ring—When several armatures of the same size are to be banded, a steel ring with a screw-type take-up or tightening device can be clamped on the far end of the coils. During the banding operation, this ring should be retightened from time to time as the banding tends to seat the coils a little more. This ring must be left on during the cure cycle.

Glass Tape Strips — In this method short 6-in. strips of glass banding tape are laid parallel to the shaft at 4-in. to 5-in. intervals on the first layer of the armature band. These strips extend out about 3 in. past the tape band toward the pinion end. Banding is then continued as close to the coil knuckle as possible. Just before the last layer of the band is applied, the free ends of these cross tapes are pulled back over the band toward the commutator. They are firmly anchored by the last layer of the band. While this technique may not produce as sharp and neat a looking job as the others mentioned, experience has shown it to be effective.

VERGE WHITTEN, shop foreman for Atlas Electric & Engineering Co., San Francisco, has his office conveniently located in the center of the motor-repair department, thereby permitting personal shop supervision, paper work, reference to filed data and phone conversations with suppliers and customers from one central location.


If this Housing ever Breaks or Distorts we will replace it Free
RIDGID
HEAVY DUTY
14

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*THIS NEW **RLM** LABEL ON AN INDUSTRIAL LUMINAIRE IS YOUR **TRIPLE CERTIFICATE OF QUALITY.***

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Look for this new RLM label on industrial luminaires. There is no similar certificate of quality in the entire lighting equipment industry.

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ECONOMICAL ON-SITE ELECTRIC GENERATION

[FROM PAGE 68]

is available, the same steam is available for heating the building or stored hot water.

Solution "B" is basically the same equipment as described in "A" except that 60-cycle power is generated for lighting as well as power. This option fails to take maximum advantage of the gas turbine generator or the compact school.

From extensive study, it was found that solutions "A" and "B" are so close in operating costs that the selection of "A" over "B" would primarily be based on a desire to obtain a higher quality of lighting and the other advantages enumerated. The first cost of "A," however, will be less than "B." On this basis we find that we can have the higher quality lighting with a substantial saving in first cost, and economics dictates the selection of system "A" over "B."

Accompanying illustrations also show the basic operating system for a large shopping center which uses a gas-turbine powered electromechanical plant. The system was designed by Maury Hughes of Leo L. Landauer and Associates, Engineers, Little Rock, Ark. Here, as in the previous case of the school, both electric power for lighting and absorption chilling for air conditioning are obtained from the single power plant.

CONTRACTORS attending the Upper Midwest 24th Annual Electrical Conference in Minneapolis included (l to r) Albert J. Stadther, Sauk Centre Electric, Sauk Centre, Minn.; Ted Wilson, Wilson Electric Co., Mora, Minn.; and Le Roy Hauer, Hauer Bros. Electric, Little Falls, Minn.

Which Okonite cable will give you the greatest circuit security?

Your Okonite cable consultant can answer that question. After he has studied your particular application, he'll be able to recommend the right cable construction for you—one that will give you long-lasting, trouble-free service. His recommendations will not be limited by a bias in favor of any particular type of cable, since *only* Okonite furnishes cable with *all* types of insulations.

The photo above is proof of the diversity of the Okonite product. It shows just a few of the many different types of cables produced by Okonite to meet the ever-changing needs of the electrical industry. Some of these cables were tailor-made to solve unusual and, perhaps, never-to-be-duplicated problems. Others are so versatile that they can be adapted to many different situations with no change in basic design. But despite their differences, these cables all have one thing in common—they're the result of Okonite Cable'bility . . . 80 years of experience in providing all types of insulations and coverings.

So, the next time you need help on a cable problem, consult Okonite. You can obtain technical assistance on any problem, large or small, by calling your nearby sales office or by writing: The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N.J.

where there's electrical power... there's **OKONITE CABLE**

FEATURING EXCLUSIVE DOUBLE-WISHBONE FINNED HEATING UNIT

Double-wishbone finned heating elements give maximum heating surface exposure . . . results in faster convection heat.

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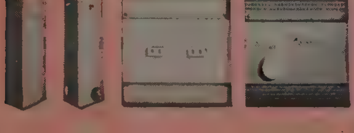
Inside and outside corners, thermostat section, wall section, all designed to blend with lines and color of baseboard units.



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Fasco electric baseboard heat is the advanced way to heat today's home It offers you and your customers a windfall of values that can't be exceede anywhere in the building industry. Contractors and builders are naturall interested in heat units that can be installed quickly and which do n require costly callbacks . . . units that are styled to please, give dependabl heat, and carry the solid, backed-up guarantee of the manufacturer—Fasc offers these things and more.

Fasco baseboard heat features unique double-wishbone heating element fo high efficiency. Varying wattages and baseboard lengths provide versatil multiples for room by room heating. Users like the slim styling, the clea uniform, draft-free heat. Front panel is easily removed for installation and cleaning.

So, before you buy, make the value check on available electric heat. You'll find Fasco has the value extras . . . for you and your customer.

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Product News

Motor Starter (1)

A combination magnetic motor starter utilizes a double-door, dead-front construction designed to discourage unauthorized entry which could bring about injuries to personnel and damage to plant equipment. Starter also meets latest JIC and automotive requirements. The dead-front panel covering the circuit breaker or disconnect may be opened with the circuit breaker or disconnect in the "off" position by loosening the captive screw on the dead-front cover. With the breaker or disconnect in the "on" position, it is necessary to operate another defeater mechanism in the switch handle before the dead-front panel may be opened. Starter consists of a 100 Line magnetic starter, control transformers and branch-circuit protective device. It is available in a NEMA Type 12 enclosure, sizes 1 and 2. Same enclosure and switch handle are used with either circuit breaker or disconnect switch form.

General Electric Company, Schenectady 5, *N. Y.*

Paging System (2)

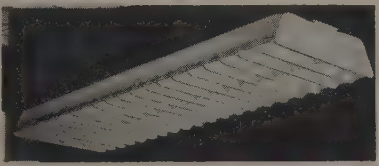
The redesigned Lokator is designed for paging key personnel in offices, banks, stores, factories, schools, etc. Each person frequently paged is assigned a one-, two- or three-digit code number. Through a network of signals, the Lokator can feed, automatically or manually, sequences of selected code impulses. In turn, these impulses cause signals to sound, at 120 beats-per-minute. Since paging is coded, privacy is assured. The selector unit is generally installed at the telephone switchboard. By means of a bracket, Lokators can be swivel-mounted on any flat surface or wall. The 20-, 40- or 80-call units operate on either 24-volt or 120-volt power. By inverting a jumper plate, power units can be converted from 24 to 120 volts.

Edwards Company., Norwalk, Conn.

Hunting Cable (3)

A new electric metal-sheathed defrosting element for clearing snow and ice from residential asphalt or concrete drives, walks and steps, has been announced. The heating cable, named Chromalox Thermwire "Snow-Bar," will withstand the 300°F temperatures present when installed in hot-pack asphalt. It can also be placed on present hard surfaces or gravel and covered with a layer of permanent surfacing material. Cable is available in 24-ft, 400-watt lengths and 40-ft, 675-watt lengths, both operating on 240 volts. These are formed into 36 in. diameter coils that can be shaped to almost any heat pattern desired, or preformed into 10-ft by 18-in. or 6-ft by 18-in. sections. Each has 10-ft leads for electrical connection.

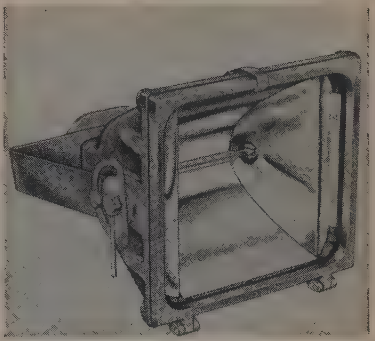
Edwin L. Wiegand Company, 7500 *Thomas Blvd., Pittsburgh* 8, *Pa.*



Lighting Fixture (4)

A new unit with refractor-lens sides has been added to the Versateer line of commercial fluorescent lighting fixtures. The side panels are clear polystyrene plastic and are .43 in. thick. Linear refractors are extruded on inside leaving smooth outer surface. The unit is designed to meet the high lighting standards required for classrooms, offices and other similar installations. Standard units are available with 35° by 25° or 45° by 45° louvers in either 2- or 4-lamp construction.

Benjamin Division, Thomas Industries Inc., 207 *E. Broadway, Louisville, Ky.*



Floodlights (5)

Model Q-500 "Quartzlite" floodlight features a 500-watt lamp 4¾ in. long in a compact cast aluminum housing. It provides beam control in plane perpendicular to lamp axis and features external wire chamber and enclosed fuse box. Versatile yoke permits mounting on wall, crossarm, pipe, pole or conduit. It is ideal for sports lighting, signs, golf driving ranges, airport and road lighting as well as for many special applications.

Spero Electric Corp., 20500 *St. Clair Ave., Cleveland* 17, *Ohio*

Splice Cap (6)

A new steel splice cap, called the 2008S, features fluted design. Eight flutes are spaced equal distance apart around the barrel of the splice cap. These flutes strengthen the cap and help to position it in the crimping tool when the 2008S is crimped, wires are flattened and formed lengthwise for wire-to-wire contact. The 2008S caps are listed as "pressure-type wire connectors" and "fixture-type splicing connectors" for two No. 18 through 4 No. 12's. Insulators are UL and CSA listed for 600 volts on building wire and 1000 volts in fixtures, in applications up to 105°C.

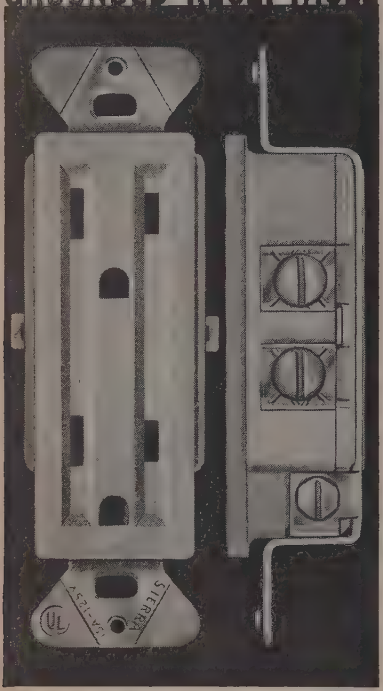
Buchanan Electrical Products Corp., Hillside, N. J.

Ballast (7)

A new two-lamp slimline ballast is designed to operate two 96-T12 430 ma lamps at rated lumen output. Core construction and clamping, together with controlled impregnation, help to insure a low noise level. Incorporated in the ballast is the upside-down design.

Sola Electric Co., 1717 *Busse Road, Elk Grove Village, Ill.*

NEW
SIERRA
BIPLEX
GROUNDED RECEPTACLE



PAT. PEND.

Biplex is the name for this handsome new duplex receptacle that adds a touch of elegance to your projects—at budget prices! This grounded duplex matches the 2-wire Sierra Triplex and fits the same plates. Biplex is UL approved and meets all codes and standards.

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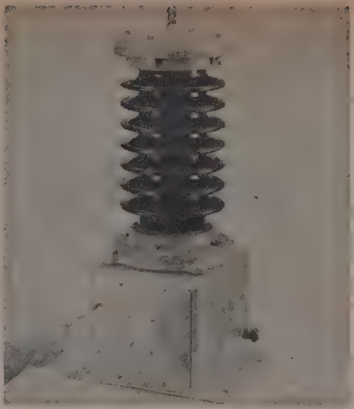


Potential Device (8)

A new potential device for monitoring voltages in the 23- to 161-kv ranges has been introduced. It is a high-voltage, oil-immersed resistor providing up to 3.5 ma as a direct function of line-to-ground voltage. With suitable accessories, the potential device can: sense voltage for automatic switching; detect grounds; indicate voltages through indicating lamps or meter instruments; supply potential for certain relays; and charge batteries. The potential device is mounted upright like a station-type arrestor or inverted, and can serve as a bus support. It is available for outdoor service on 23-1-1, 34.5-1-1, 46-1-1, 69-1-1, 115-1-1, 138-1-1, and 161-kv systems and for indoor service on 23- and 34.5-kv systems.

S&C Electric Co., 4435 *North Ravenswood, Chicago* 40, *Ill.*

Connectors and Couplings (9)

A completely new line of concrete-tight set screw thinwall connectors and couplings for thinwall conduit. Fittings are made of heavy, one-piece steel and are electroplated to resist rust and corrosion. The interior of connectors features smooth conduit stop collars over which wires may be pulled easily. The edges of connectors are chamfered, and they have heavy duty "tiger-grip" locknuts. They are available in ½, ¾ and 1 in. sizes. Bulletin TWT-161-1 is available.

Appleton Electric Company, 1701 *Wellington Ave., Chicago* 13, *Ill.*

Testing Kit (10)

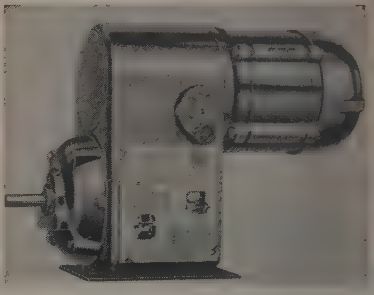
A testing kit, which includes a new snap-around instrument that measures voltage, amperage and resistance, is called Amprobe Junior Testmaster. Instrument can be used in estimating, and for the installation, trouble shooting, production, engineering and maintenance of electrical equipment and appliances of all types. Completely insulated, the Amprobe is pocket-sized for one-hand operations, measuring 4¾ in. high. The kit consists of the instrument, an ohmmeter battery attachment, two safety-type leads, the Amprobe Energizer and a cowhide leather carrying case. Catalog Sheet AAD-1 is available.

Pyramid Instrument Corp., Lynbrook, N. Y.

Support (11)

A new service mast support with sideways adjustability has been announced. Hanger mounts on building with a special wood screw and is called "Adjusto-clamp." Sideways adjustability permits straightening mast after installation and aligning mast with meter socket. Catalog No. 7544 is for 2-in. pipe and 7545 for 2½ in. pipe.

Porcelain Products Co., Carey, Ohio.



Motor (12)

A new design Varidrive explosion-proof motor, Type VA-EV, in ratings of ¼, ⅓, ½, ¾ and 1 hp has been announced. It offers variable speeds in ratios up to 10:1 for applications in which explosive atmospheres of fumes or dust are encountered. It is UL listed for service in locations of Class I, Group D, which are characterized by the presence of highly inflammable gases and volatile liquids, and Class II, Groups E, F, and G, which are rendered hazardous by combustible dusts. The Varidrive can be mounted in a variety of positions — upright, horizontal, shaft-up, shaft-down—on walls, ceilings, or available surfaces in or on machines.

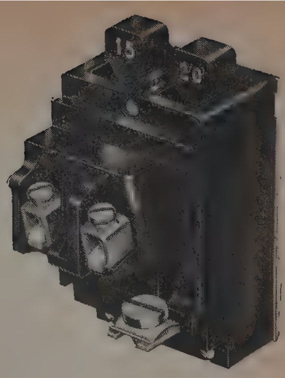
U. S. Electrical Motors, Inc., P. O. Box 2058, *Terminal Annex, Los Angeles* 54, *Calif.*

KNOW YOUR SYMBOLS

This symbol stands for circuit breaker

This symbol stands for QUALITY

BullDog Duplex Pushmatic—



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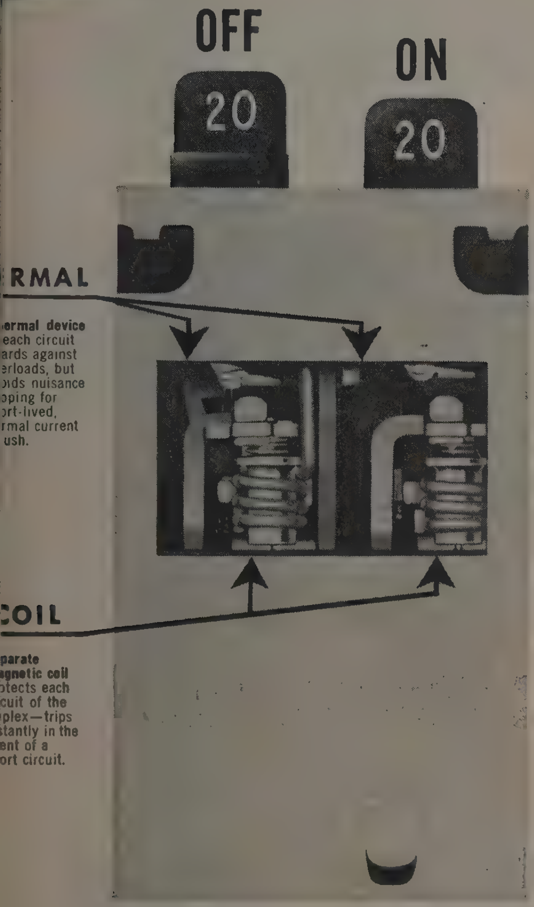
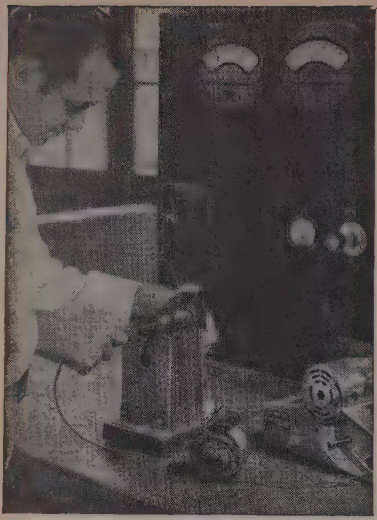


The leader in safety . . . BullDog's Duplex Pushmatic® circuit breaker provides two protective systems in each circuit. A thermal control teams up with a magnetic coil to assure maximum protection under *any* residential operating condition and to avoid nuisance tripping. Bolted bus-bar connection assures tight, positive contact that prevents overheating. This maximum electrical safety is your best protection against costly trouble calls!

The leader in convenience . . . the Duplex Pushmatic puts two general-purpose circuits, 15 or 20 amps, in the panel space of one—provides maximum circuit flexibility with smaller, less expensive panels. And the Duplex is the *only* breaker with exclusive pushbutton convenience. Also, a tripped breaker can be identified instantly by sight or touch, resets with a push of the finger. For complete details on Pushmatic breakers and panels, write for your "Pushmatic Pocket Guide"—*it's free!*

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Mich. In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 East 40th St., New York 16, N. Y.

I-T-E CIRCUIT BREAKER COMPANY
BULLDOG ELECTRIC PRODUCTS DIVISION



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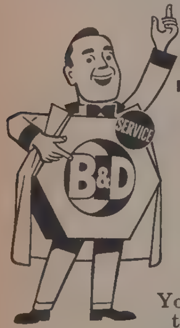

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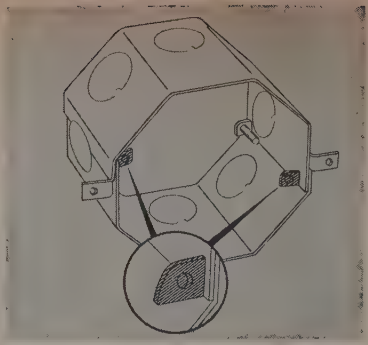


Protective Compound (13)

A new exclusive plastic compound called "Aro-Gard" is now used on all concrete rings for permanent protection of the tapped holes. Compound is hard enough to keep concrete from entering the tapped holes, yet soft enough to allow screw to penetrate the protective film with ease. It also prevents concrete from sticking to the ear-lug. The presence of "Aro-Gard" is identified by its bright green color.

Arrow Conduit & Fittings Corp. 108-20 180*th St. Jamaica* 33, *N. Y.*

Control (14)

A new automatic set-back control system for use in motels, schools, churches and residences, lowers or raises temperature of unoccupied rooms by remote control. Flick a switch at the central control panel, and the thermostat in a room drops to "low" or goes up to "normal." The occupant, however, in the room can still adjust the temperature at any time. Unit is specially designed to operate with all Emerson electric heating units.

Emerson Electric Manufacturing Co., 8100 *Florissant, St. Louis* 36, *Mo.*

Switches (15)

NEMA 12 panel enclosures for mounting the new externally operated disconnect switches are now available. A front mounting disconnect means provides a safety device for control enclosures. When installed in the enclosure, the handle is never separated from the disconnect mechanism and can be locked in the "off" position when the door is open or closed. The door is positively latched with a 2- or 3-point operating mechanism, but a "bypass" allows authorized inspection or service in the "on" position. The oil- and dust-tight enclosures are formed from 12 or 14 gauge steel with welded seams and gasketed door. Box sizes run from 20 by 20 in. up to 60 by 37 in. in varying depths.

Hoffman Engineering Corp., Anoka, Minn.

Puller (16)

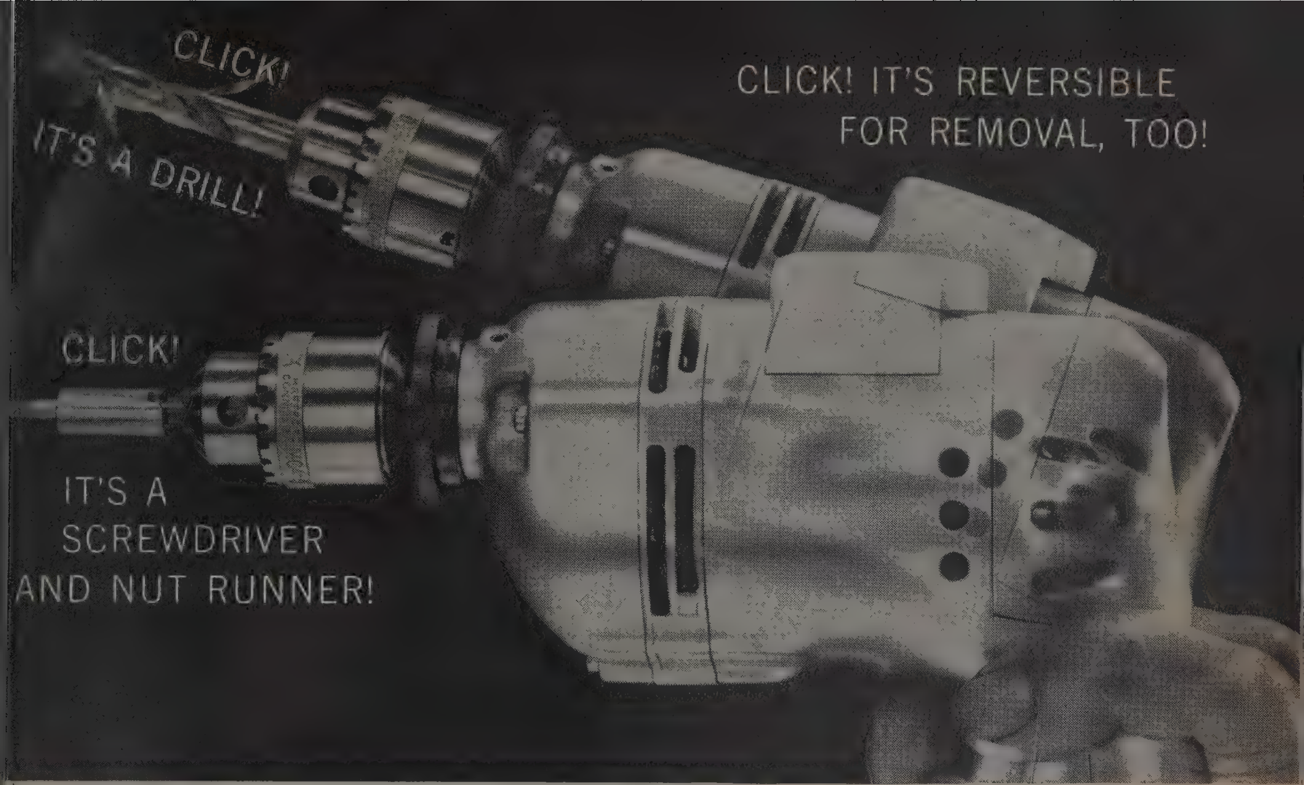
The Hercules Porta-Puller has been re-designed. Improvements include: a stronger frame; double reduction winch; heavy-duty bearings; double extra strong pulley-head and stronger supporting stub. Unit comes equipped with 200 ft of cable, but by means of the Bull Wheel longer pulls can be made.

Fairfield Industries, Caldwell, N. J.

Enclosures (17)

Individual enclosures for its new line of K-Don circuit breakers, low-voltage current-limiting units affording fault protection against currents as high as 200,000 amps, have been developed. The K-Don breakers are now available in the new enclosures for many applications in industrial plants, commercial buildings and institutions where single, wall-mounted breakers are used. The enclosures afford such benefits as large and accessible cable make-up area; ease of trip unit adjustment and general maintenance and service; draw-out operation; and visible break disconnect contacts. Individually enclosed K-Don breakers are available for electrical or manual stored-energy operation in 600- and 1600-amp ratings, up to 600-volt ac or 250-volt dc operation. Bulletin 4300-1A is available.

I-T-E Circut Breaker Company, 1900 *Hamilton St., Philadelphia* 30, *Pa.*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CLICK! IT'S REVERSIBLE FOR REMOVAL, TOO!
CLICK!
IT'S A SCREWDRIVER AND NUT RUNNER!

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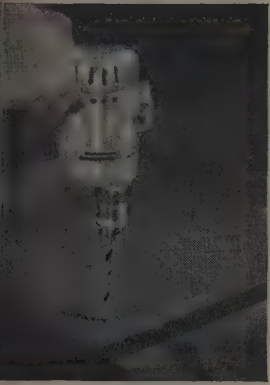
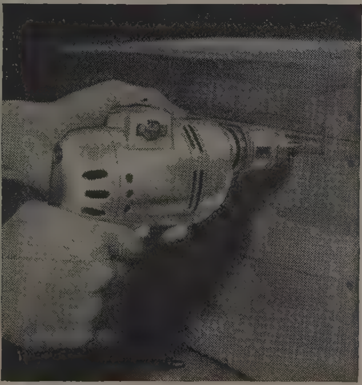


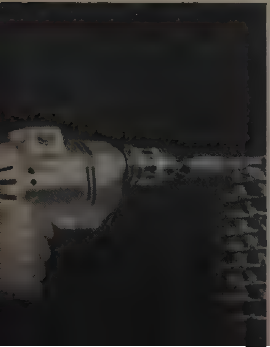


DRILL in metal or wood. Powerful B&D motor gives you full ⅜" capacity in steel, ¾" in wood.

DRIVE screws, nuts or bolts with same tool. Handles #10x1½" wood screws #12 self-tapping.

REMOVE as many as 60 screws, nuts and bolts in 60 seconds. Just flip the reversing switch.

REVERSING switch is *piggy-back* mounted for convenience. You can flip it with your thumb.



SPEED WORK with this lightweight 2 in 1 tool.

Imagine! A simple turn of the wrist and you switch from drill to screwdriver. A flip of a switch and you're removing screws, nuts and bolts. Remove a bolt, oversize the hole, run a new bolt—as easy and fast as 1-2-3 *and all with the same tool*, your new Black & Decker ⅜" Reversible Scru-Drill!

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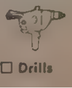
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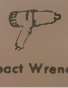
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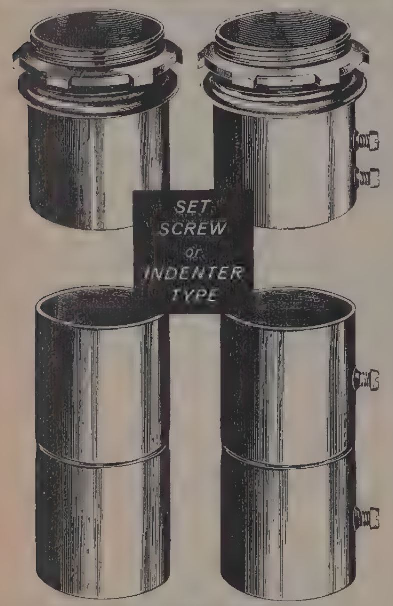
E.M.T.
Electrical Fittings



Why settle for ordinary couplings & connectors when ETP gives you all these EXTRAS:

- Sparkling corrosion-resistent zinc chromate overplating for lasting performance.
- One piece tubular steel — cannot open or spread.
- Concrete tight. Far surpasses ULL. File Card E 24788.
- Exclusive pre-set, deep-slotted staked heavy duty locknuts.
- Special formula soft steel for easiest indenting.
- Competitively priced! Boxed every size from ½" to 2".

CONNECT WITH ETP FOR ECONOMY

WRITE TODAY FOR SAMPLES AND PRICE LIST

Electrical Tubular Products, Inc.
74-16 GRAND AVENUE, MASPETH, (N.Y.C.) N.Y.
DEfender 5-8000

Motor Starters (18)

A new line of JIC NEMA 12 combination motor starters with QMQB fusible disconnects has been introduced. With a wide range of industrial applications, they are particularly adaptable for use in single motor machinery located where oil or non-explosive dust is a problem. The smallest unit is $8\frac{3}{16}$ in. wide, $6\frac{5}{16}$ in. deep, and $29\frac{5}{6}$ in. high, and is so engineered that it can be installed within the web of a 10-in. I beam. The interlocking system of the new motor starters includes a heavy duty door handle interlocked with the door. Starters are available in a variety of units, with motor starters ranging from NEMA 0 to 3, fusible or non-fusible, reversing or nonreversing.

Federal Pacific Electric Co., 50 *Paris St., Newark, N. J.*

Switch (19)

A 4-way Touch-A-Matic ac quiet switch has been introduced. They are equipped with enclosed suretight E-Z wire (rear) pressure terminals. It is a low-decibel quiet switch with light touch instant action. The full range of Touch-A-Matics include single pole and 3-way, flush and interchange types; 15- and 20-amp, 120-277-volt ac.

Eagle Electric Mfg. Co., Inc., 23-10 *Bridge Plaza South, Long Island City* 1, *N. Y.*

Enclosures (20)

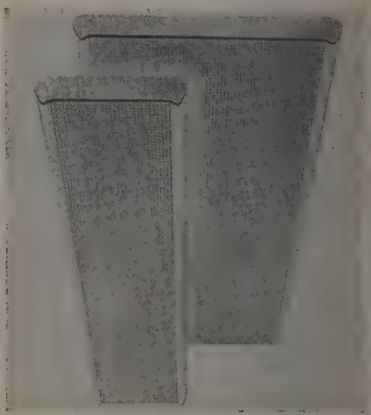
New NEMA Type 12 disconnect switch enclosures, designed for safety and easy installation of the new Square D type disconnect switch, have been added to the Boss line of electrical equipment. They are manufactured to complete NEMA and JIC standards. Steel removable panel is mounted inside on collar studs. Two mounting feet are arc welded. Cabinet interior and mounting panel are finished in baked-on white enamel. Exterior is gray prime coat. They come in seven standard stock sizes, offering a height and width selection ranging from 24 in. by 20 in. to 42 in. by 30 in., with a constant depth of 8 in. in all sizes. All enclosures are furnished with two switch brackets to permit use of either 30- or 60-amp switch.

Huenefeld Co., 2701 *Spring Grove Ave., Cincinnati* 25, *Ohio*

Poles (21)

A new strain hardening aluminum tapered pole for use as street, highway and off-highway lighting poles; traffic signal poles and overhead supports. New applications are expected to be developed for floodlighting poles, antenna masts, and other structural uses. The standard product is provided with a taper of .14 in. per foot. The diameters may range from 4 to 24 in. with lengths of single tapered tubes up to 40 ft.

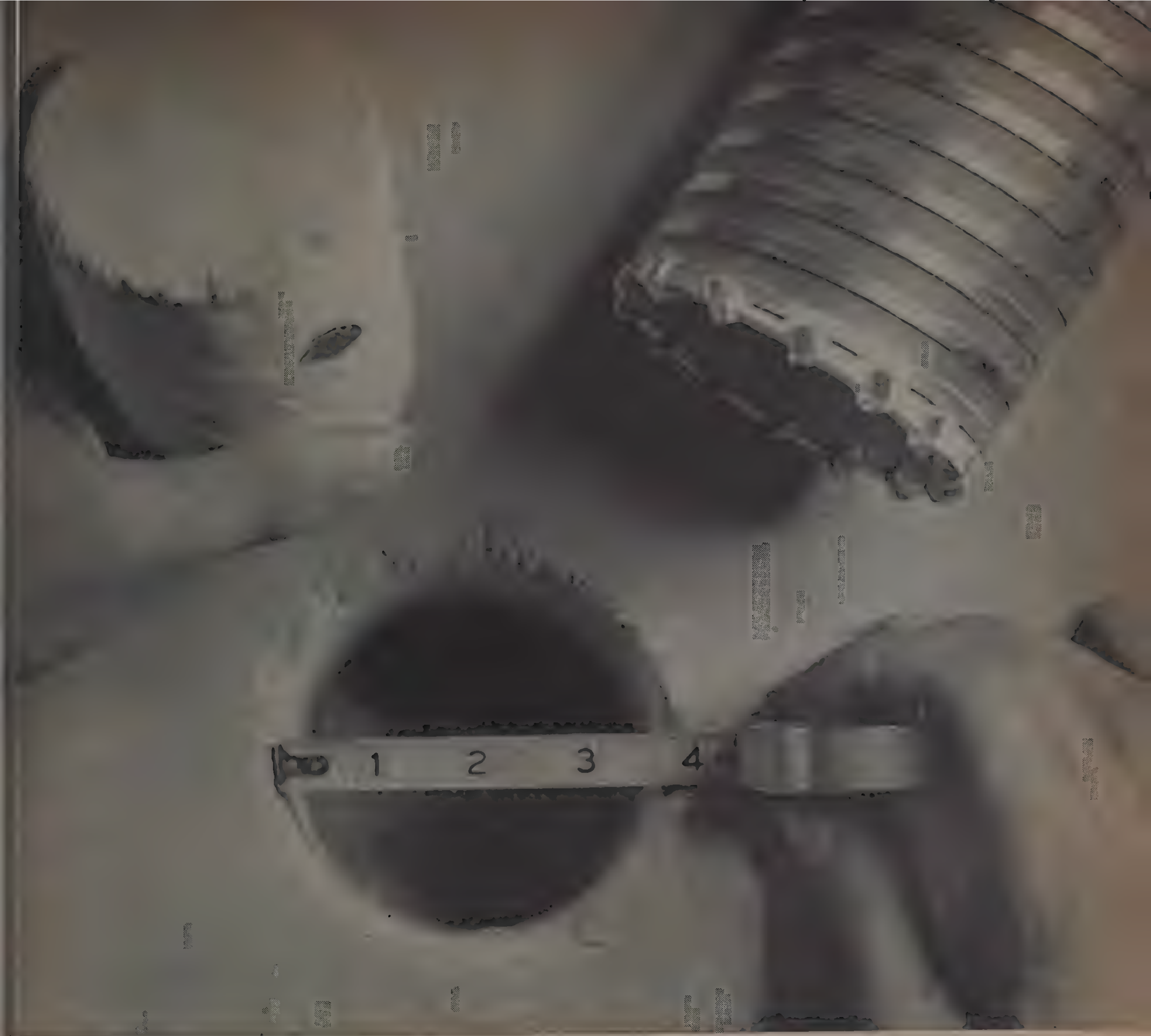
Union Metal Manufacturing Co., Canton, Ohio.



Lighting Fixture (22)

A new, shallow, fully enclosed, all-plastic, shielded lighting fixture, called Starama, is designed primarily for surface mounting. The "wrap-around" diffusing enclosure consists of translucent white side panels interlocked with a lens bottom panel. Plastic enclosure is framed in metal. Fixture may be opened from either side. Unit is available with either Sunlux or Opalux panels. Unit features an air-pocket above the channel which insulates heat from the ceiling. Channel is designed to conduct heat away from top and bottom of ballast. Fixtures are available for 2- or 4-lamp rapid-start operation.

Sunbeam Lighting Co., Los Angeles, Calif. and Gary, Ind.



Now! Skil Roto-Hammers drill 3½″ holes in reinforced concrete

using new percussion carbide tipped Skil Core Bits!

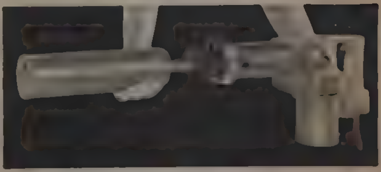
There are plenty of good reasons why the Skil Roto-Hammer is sure to be the world's largest selling hammer again in 1961! But one of the foremost is Skil's new core bits.

These hollow core, percussion type carbide bits increase the range of the Model 726 Roto-Hammer from 1⅛″ up to 1½″ and the Model 736 from 2″ up to a full 3½″!

What's more, they drill right through stubborn steel reinforcing rods—an impossibility with solid-carbide bits or star drills.

This means that the hammer that already drills masonry holes at the *lowest cost per hole* and with *lowest hammer maintenance*, has tremendous added versatility.

Ask your Skil distributor for a demonstration soon. Look under "Tools-Electric" in the Yellow Pages. Or write: Skil Corporation, Dept. 130F, 5033 Elston Avenue, Chicago 30, Illinois.

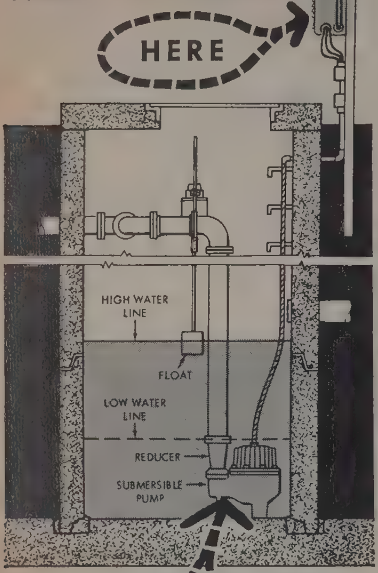


Skil Roto-Hammers combine power rotation with powerful hammering to drill holes in masonry (¼″ to 3½″) 5 to 6 times faster than ordinary electric hammers! Lowest maintenance—no springs to break.

SKIL . . . and SKILSAW POWER TOOLS

★ "MARKETS UNLIMITED" ★

Add-A-Phase®



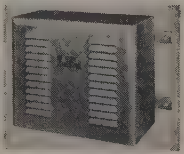
means 3-PHASE 220 or 440 SUBMERSIBLE OPERATION HERE from Single Phase Lines

Now, get all the benefits of dependable 3-phase submersible pump operation and be assured of trouble-free, continuous full power output with the ADD-A-PHASE Power Converter. Absolutely no expensive 3-phase wiring necessary. The Add-A-Phase is easily installed by any qualified electrician.

UNIT BALANCES OUT PERFECTLY FOR ANY LOAD

Add-A-Phase POWER CONVERTER

- 100% Rated Load
- High Power Factor
- Balanced Currents
- No Loss of Work Power



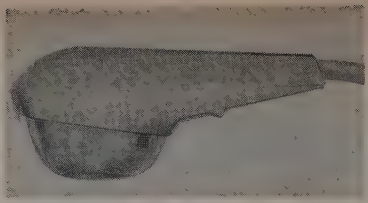
Write for Complete Information

ADD-A-PHASE ECM-6
Div. System Analyzer Corp., Nokomis, Illinois

Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name__________Title__________
Company__________
Address__________
City__________Zone__________
State__________

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.



Luminaire (23)

A new roadway lighting luminaire for 700- and 1000-watt clear- and color-corrected mercury lamps is now available. The unit, designated Type OV-50 Silverliner, has been specially designed for illuminating extra-wide roadways. It also has wide application in parking lots and shopping plazas. Two styles of luminaire can be supplied—one with a built-in regulated output ballast and the other designed for remote ballast operation. Unit with a built-in ballast has a capacitor housing which fits on top of luminaire. Provisions have been made in the design of the luminaire so that each lamp can be controlled by a photocell.

Westinghouse Electric Corp., Lighting Div., Edgewater Park, Cleveland, Ohio

Motor Insulation (24)

The "Capsulex" insulation system has been especially developed for encapsulated formed coils used in large ac motors ranging in sizes from 200 to 2000 hp. The new insulation system provides added protection to windings against moisture, chemicals, oils and abrasive contaminants. Capsulex is available in open, drip-proof, splash-proof and weather protected motors built in frame sizes larger than 445U—for operating voltages of 208 to 5000 volts. Bulletin No. 3700 is available.

The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.

Fire Alarm Systems (25)

A new line of "compact" fire alarm systems are now available on an "off-the-shelf" basis. Compact line covers non-code, closed-circuit supervised, plain-code supervised, shunt non-interfering coded supervised systems. Units are completely pre-wired, ready for installation in most commercial and public buildings; are designed for use in small schools, hotels, office buildings, apartment houses, stores and other small buildings. Also available for more complex applications: a complete line of unitized modular, pre-engineered systems designed around 17 basic modular panels. Redesigned call stations have Alert-O-Glass identification labels to attract attention. Modular systems carry UL label, operate on 120/240-volt, 60-cycle, 3-wire power supplies.

Faraday, Inc., Adrian, Mich.

Transformer (26)

A low-voltage transformer designed to provide safety when working in damp buildings, on grounded locations, inspecting tanks and boilers, and around machinery. Transformer is portable and equipped with a 6-ft primary cord of No. 16/3 Type SO and U-blade grounding plug cap which can be plugged into any 125-volt ac circuit. Secondary side of transformer is equipped with two U-blade grounding receptacles which provide for use of two 32-volt or two 12-volt extension lights. Available for either 32-volt or 12-volt service. Capacity of transformer is 150 watts.

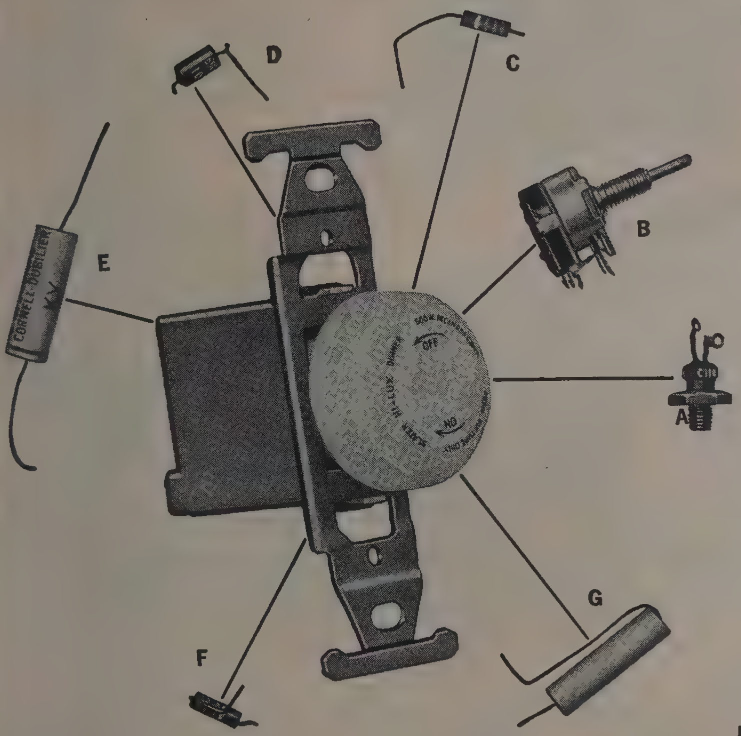
Ericson Manufacturing Co., 1660 Hayden Ave., Cleveland 12, Ohio

Circuit Breakers (27)

A new line of Stab-lok circuit breakers and enclosures modified to meet the new 1959 NEC requirements for non-interchangeability. The design change, however, does not obsolete existing Stab-lok installations as the new circuit breakers can be used in old or new devices. The line is based on a design whereby breakers are fitted with hardened steel clips that prevent breaker from being stabbed in until one or two knockouts in the enclosure are removed. The 15-amp and 20 amp breakers are installed by stabbing them in.

Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

Slater proves again...QUALITY COSTS NO MORE!



HI-LUX COMPONENTS

- **A** Silicon Control Rectifier
- **B** Switch & Potentiometer
- **C** Resistor
- **D** Silicon Rectifier
- **E** Condenser
- **F** Resistor
- **G** Condenser

HI-LUX ROTARY DIMMER
RATING: 500 WATTS
FOR INCANDESCENT LOADS ONLY

BIG PROFITS COME IN THIS SMALL PACKAGE

The Slater HI-LUX Rotary Dimmer gives you bigger profits with every installation—the reason is simple. HI-LUX is the only *electronic* dimmer made...needs no bulky transformers or rheostats. Its compact size means you can install HI-LUX in any standard switch box using standard wiring...only 2 connections are required. Because HI-LUX installs so easily you'll save on labor and pocket bigger profits on every job.

HI-LUX Rotary Dimmers are available with standard mounting (illustrated) or interchangeable mounting for use in 3 or 4-way circuits. For additional information and prices write today...

NOW AVAILABLE! THE NEW 64 page Slater READY REFERENCE CATALOG for Architects, Engineers and Contractors.

Lists over 600 lifetime wiring devices including the HI-LO dimswitch for 2-stage lighting and the revolutionary HI-LUX rotary dimmer.

Slater ELECTRIC INC.

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Slater Electric Inc.
Dept. CF
Glen Cove, New York

Gentlemen: ☐ Please send me more information and prices on the HI-LUX Rotary Dimmer.
☐ The Ready Reference Catalog.

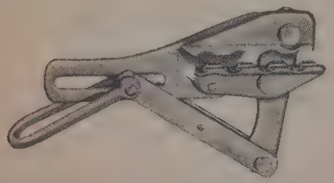
NAME..
COMPANY..
ADDRESS...
CITY.................................ZONE......STATE........

60 DIFFERENT KLEIN GRIPS MEET EVERY UTILITY NEED

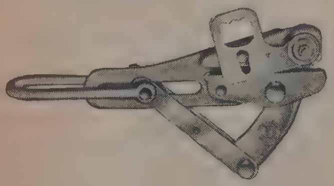
If you want a strong, nonslipping grip for use on any type of conductor . . . if you need a pattern specially designed for hot line work . . . consult your Klein Catalog. Klein grips are designed for solid and stranded cable, for messenger guy strand and wire rope, and for weatherproof wire.

Write for the Klein Grip Selector to make sure you have the proper grip for every job.

1656-40B with bronze-lined jaws. Specially designed for bare A.C.S.R. aluminum and stranded copper cable.
Opening from .50 to .74 inch.



Machined jaws allow snaking insulated conductors, eliminating slippage and preventing conductor damage. Insulation does not have to be stripped from conductor.
1659-40—openings from .49 to .80 inch.

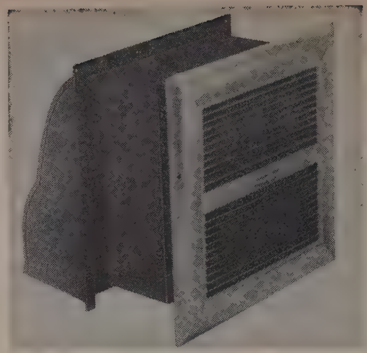


This hot line grip may be placed on wire with stick. Safety latch has three positions and closes automatically when stick is removed. Cannot fall off wire. Can be used for hot or dead work.
1628-5BH—openings from .198 to .522 inch.

FREE GRIP SELECTOR
To utility companies, the grip selector is available without charge. It shows the proper Klein grip for any type of wire and gives full information for servicing.

Foreign Distributor:
International Standard Electric Corp., New York

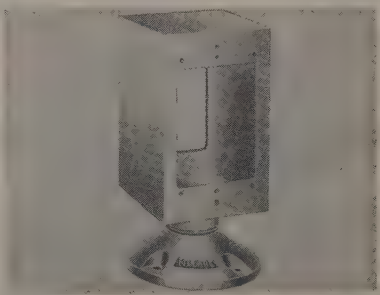
Mathias KLEIN & Sons
Established 1857
Chicago Ill U.S.A.
INCORPORATED
7200 McCORMICK ROAD, CHICAGO 45, ILL.



Exhaust Fans (28)

Seven new Emerson-Pryne exhaust fans in a square design have been announced. Improved air movement is achieved through use of a venturi and larger opening. Air is immediately available to blades providing more CFM air movement with less wattage. The wall fan version has a new patented damper arrangement, designated Tensomatic shutter, that eliminates backdrafts and "shutter flutter." Both sidewall and ceiling fans are available.

Emerson Electric Company, 8100 *Florissant, St. Louis* 36, *Mo.*



Fitting (29)

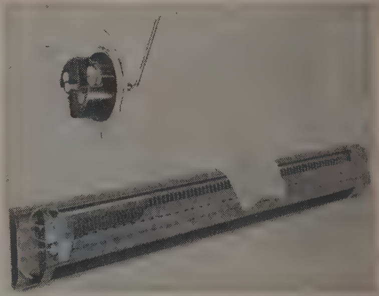
A versatile flange fitting for use with receptacle outlets, switches, pilot lights, Electrolets, FS fittings and similar units. It can be mounted on 3¼ in. outlet boxes, junction boxes, or directly on table tops or other surfaces. Device is all rust-proof aluminum.

Killark Electric Mfg. Co., 3940 *Easton Ave., St. Louis* 13, *Mo.*

Fuse Block (30)

A new 4-circuit plug fuse block that is interchangeable with 30-amp and 60-amp pullouts in its 100/200-amp Add-on service equipment line is available. Fuse block is designed to permit installation of additional 15-, 20- and 30-amp fused branch circuits to meet present and future residential electrical needs with existing entrance equipment. Ideally suited for electric heat installations, the new block has opposite polarity, will not unbalance loads. Available in two types. Model CP-215 will take 15-, 20- and 30-amp fuses and CPS-215, which is identical, is designed to accept type "S" fuses only. Both are listed as standard by UL.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.



Heaters (31)

Electric baseboard heaters are now equipped with a new safety device to prevent overheating should something fall on the heater. It is known as the "Safe-T-Stat" and when a handkerchief, or any other object, is dropped on the heater it causes a rise in temperature. This increased temperature is immediately transmitted along a liquid filled capillary tube which runs the full length of the heater. The "Safe-T-Stat" is then activated to break the circuit and shut off the power. After a 50° temperature drop, power is automatically switched on. This means that as long as the object remains against the heater this off-on safety cycle repeats itself.

Seaboard Products Corp., 191 *Frelinghuysen Ave., Newark, N. J.*

Busduct (32)

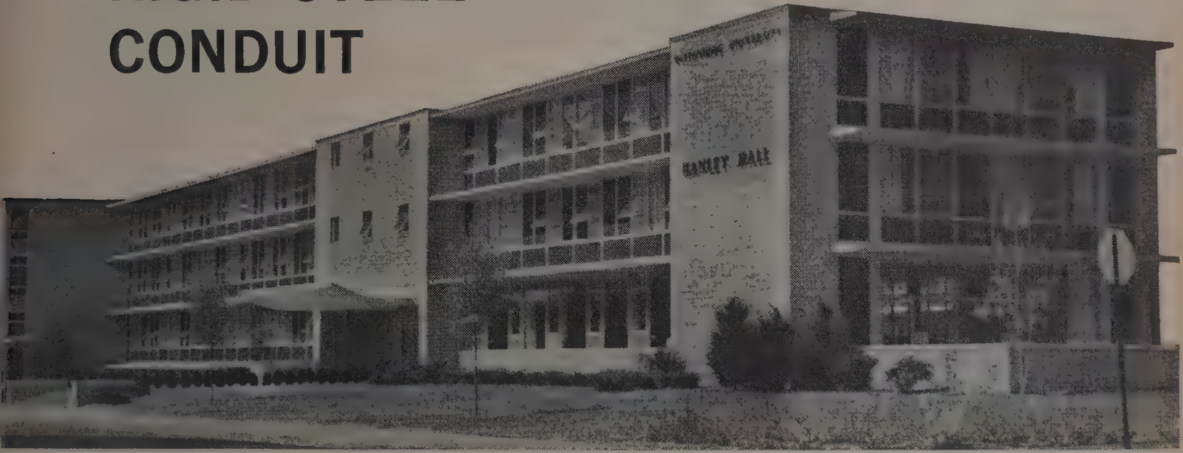
A form of busduct for 100-amp electrical systems is intended to provide the advantages of a rigid distribution system for installations where small blocks of power are used. It has a continuous rating of 100 amps, with a voltage rating of 600 volts for 3-wire systems and 277/480 volts for 4-wire systems. Joints snap together by means of special high pressure spring clips. Two plug-in openings are located every 2 ft along length of run. Duct is available in 10-, 5-, 3,- 2- and 1-ft sections.

Westinghouse Electric Corp., Standard Control Div., Beaver, Pa.

Lift-slab construction
at Wittenberg University
features dollar-saving

REPUBLIC RIGID STEEL CONDUIT

LIFT-SLAB CONSTRUCTION AT WITTENBERG UNIVERSITY. Reinforcing bars and Republic Rigid Steel Conduit are installed at ground level, concrete poured, slab is raised into position.



Hanley Hall, Wittenberg University, Springfield, Ohio
Architect: Zeller Hunter, Springfield, Ohio
Mechanical Engineer: W. C. Koenig & Associates, Springfield, Ohio
Electrical Contractor: Free Electric Company

Smooth, accurate bends of high ductility Republic Rigid Steel Conduit made electrical installation easy in this addition to the women's dormitory, Wittenberg University, Springfield, Ohio.

High quality Republic Rigid Steel Conduit is made of strong, soft, yet workable steel with complete freedom from "burnt" or hard spots. Welds are sound, smooth, and strong. Inside surface is clean, without burrs or rough spots, resulting in easier wire pushing or pulling.

Republic Rigid Steel Conduit is produced in two finishes. GALVITE® with a surface fully protected by a hot-dipped galvanized coating inside and out. Does not peel, chip, or flake under usual bending. Threads are zinc protected, uniformly clean and sharp for ease and speed in fitting up the job. ENAMELITE® protected inside and out with a heavy baked-on coating of black enamel.

Republic Conduit is furnished to ASA and Federal Specifications, meets rigid electrical codes and is listed by Underwriters' Laboratories, Inc.

Stocked in standard trade sizes ½" through 6" by leading electrical distributors. Write for full information.

TIGHT, WRINKLE-FREE BENDS in Republic Rigid Steel Conduit make possible accurate, cost-saving installation. Galvanized coating remains unbroken, provides maximum protection.

Galvanized Steel

Strong, Modern, Dependable

REPUBLIC STEEL

REPUBLIC STEEL

REPUBLIC HAS THE FEEL FOR MODERN STEEL

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. A-2200
212 EAST 131st STREET, CLEVELAND 8, OHIO

I want to know more about Republic Rigid Steel Conduit. Please send additional information.

Name________________Title____________

Firm____________________________

Address__________________________

City____________Zone_____State________

FULLMAN'S *Adjustable* STEEL BOX
190-N R Series
No Receptacle
with 2-PART TIN LID

A standard 4" octagon, brass-topped watertight floor box 2½" deep with brass adjusting ring permitting ½" height adjustment in addition to three screw legs 2½" long.

A 2-Part Tin Lid is provided in order to pour concrete to very top in one operation. After concrete is hardened, the top part of the 2-part tin lid can be removed along with top adjusting ring section, providing all the room you need for conduit attachment or wire pulling.

A "KEY" designed to fit most popular size and style receptacles has been added at no extra cost.

Adjusting ring for our #190 series is so designed that "KEY" (shown in center of photo) drops easily into special slots. You select the receptacle required and simply "LAY-IN"; then "LAY-ON" receptacle ring.

Short Stem TELEPHONE *and* DUPLEX NOZZLES

These modern, flanged, short stem duplex telephone and receptacle nozzles come in satin brushed brass or anodized aluminum. Standards fit ½" opening. ¾" stems are available, also grounded type receptacles.

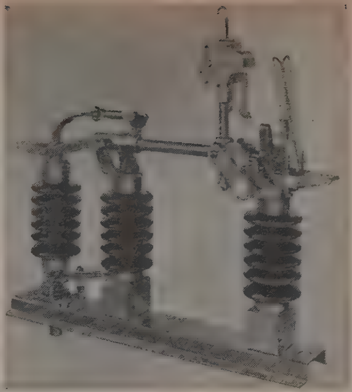
BRASS *and* ALUMINUM

Sales Representatives in all principal Cities

Sold only thru wholesalers

FULLMAN MANUFACTURING CO. QUALITY A.T. LATROBE O.B. SUPREMACY LATROBE, PA.

Fullman
MANUFACTURING COMPANY
1209-1215 JEFFERSON ST.
LATROBE, PENNSYLVANIA



Switch (33)

The ARI-60 new distribution load break switch was designed to provide for distribution switching equipment. It is built for use at 600 amps in ratings of 7 x 7.5, 15 and 23 kv. Some of the features are: rotating blade, high-pressure contacts, and an enclosed hinge for corrosion and ice resistance. The ARI-60 is literally a small power class switch, incorporating three insulator stacks with a vertical blade motion controlled by rotation of the rear stack. The front contact is arranged to utilize the magnetic effect of increased current to build up contact pressure under short circuit.

James R. Kearney Corp., 25th & Division Sts., Melrose Park, Ill.

Step Light (34)

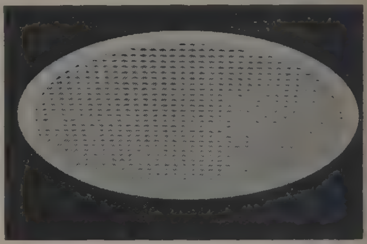
A new Rayescent safety-step light has been designed for use on steps, aisles, and walks. Light is ½ in. thick, allowing it to be mounted on existing stair risers. Either green or yellow light is produced. Unit measures 4 by 8 in., and it has concealed wiring. It consists of a flat lamp, a metal frame, and two wires. Lamps have a rating of one watt at 120 volts ac. Flat panels of glass with an electrical conductive film are coated with a special phosphor.

Westinghouse Lamp Division, MacArthur Ave., Bloomfield, N. J.

Receptacles (35)

New TV receptacles and caps in the Despard interchangeable type, suitable for all types of TV installations, are now available. They come in brown or ivory and are furnished as one unit. Usable in standard outlet boxes, TV receptacles may also be installed in combination with other Despard devices. A one-gang installation of two TV receptacles with caps will provide connections for UHF and VHF. Dimensions of receptacles are $1\frac{1}{2}$ in. long, $\frac{13}{16}$ in. wide and $\frac{13}{32}$ in. deep under mounting surface. Cap dimensions are $\frac{7}{8}$ in. long by $\frac{1}{2}$ in. wide by $\frac{9}{16}$ in. deep.

Pass & Seymour, Inc., Solvay Station, Syracuse 9, N. Y.



Fluorescent Fixtures (36)

Louvered round fluorescent recessed 2-ft and 4-ft diameter fixtures have been developed. The round units, 700 Series, features new small cell aluminum louver, Scallop-Cel, with vinyl plastic laminated to the top for complete shielding of lamps from all viewing angles. Brochure is available.

Neo-Ray Products, Inc., 315 *East* 22d *St., New York* 10, *N. Y.*

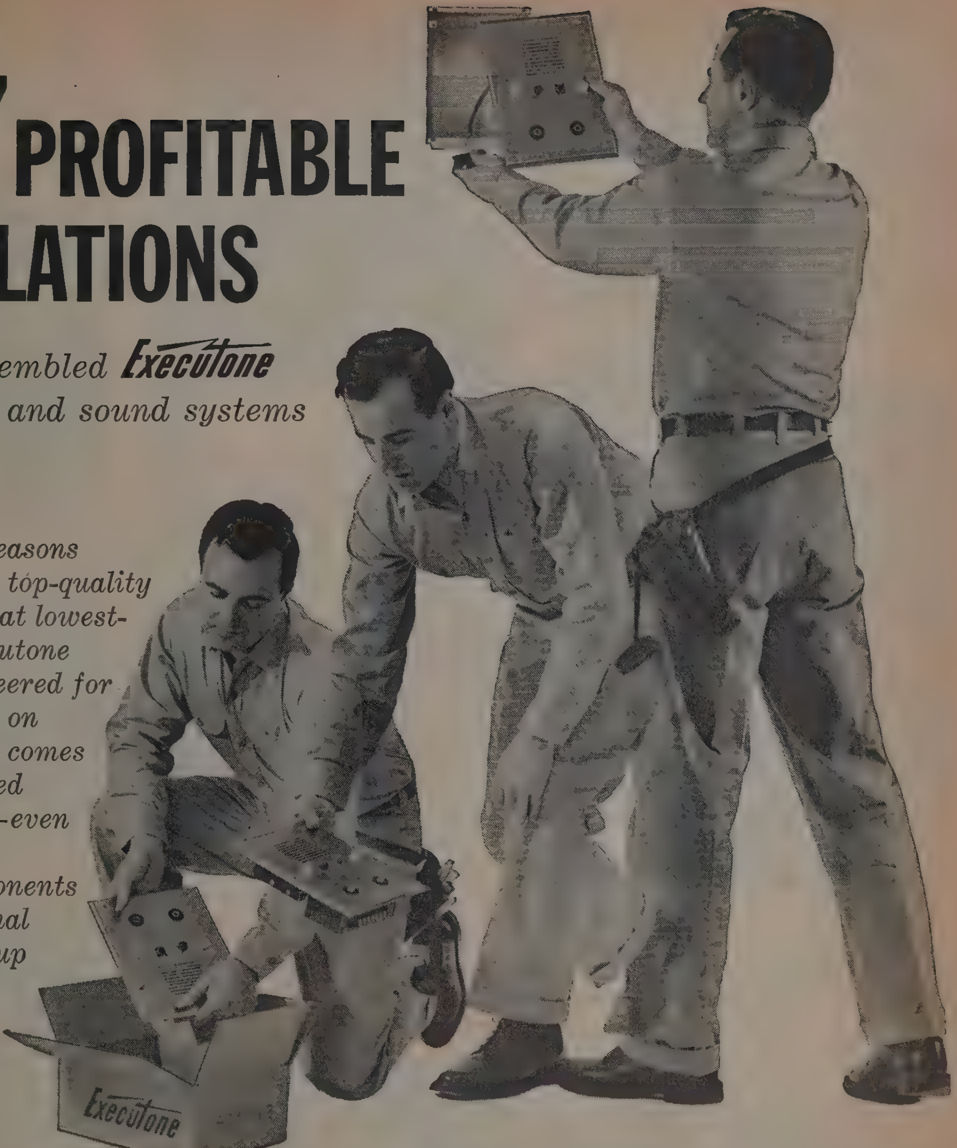
Plastic Fittings (37)

Belled-end fittings that facilitate inserting power cables at the start of underground conduits of thermoplastic pipe has been announced. Fittings are fabricated from stock sizes of polyethylene or other thermoplastic piping. They have one bellshaped end that flares to approximately twice the outside diameter of the pipe. The other end is normal pipe size for coupling by heat sealing, or solvent cementing in the case of polyvinyl chloride, to runs of plastic pipe used to guard underground power lines against corrosion and electrolytic action. A ring, thermally welded around the body of fittings, provides an anchor in concrete.

Tube Turns Plastics Inc., Louisville, Ky.

FASTER, MORE PROFITABLE INSTALLATIONS

with factory-assembled **Executone**
intercom and sound systems



Here's one of five reasons why you can put in top-quality Executone systems at lowest-installed-cost. Executone equipment is engineered for least assembly time on the job. Every unit comes completely assembled and factory-tested—even consoles, racks and reproducers. Components have plug-in terminal blocks, to cut hook-up time to a bare minimum. Check these other profit-building Executone Extras:

- **EXPERT PRE-PLANNING:** assistance in system layout, preparation of bids and estimates.
- **COMPLETELY ENGINEERED SYSTEMS** from one source—even including special color-coded wire.
- **INSTALLATION SUPERVISION** helps you finish fast . . . assures proper hook-up, adjustment, check-out.
- **NO SERVICE CALL-BACKS** because Executone takes full, immediate responsibility for operation of the system.

Start building profits the Executone way. Check the coupon below for information on Executone sound and communication equipment for selected building types. We'll also send you a convenient Conduit Selection Chart to help you cut costs in layout and installation.

Executone
COMMUNICATION AND SOUND SYSTEMS

Executone, Inc., 415 Lexington Ave., Dept. C-11, New York 17, N. Y.

Send me your Conduit, Wire and Cable Chart. Also: information on Executone equipment for

☐ schools ☐ hospitals ☐ offices ☐ plants ☐ retail stores ☐ homes ☐ other______

Name________________________

Company________________________

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City________________ Zone________ State________

In Canada: 331 Bartlett Avenue, Toronto

Of Course they Snap-on!
End Costly Mismatches with famous
"SIZE-MARKED"
MINERALLAC®
Jiffy®-Clips

Minerallac—the originator of the famous and widely imitated "Jiffy-Clip"—is the only company to make FOUR complete lines of these clips. The most complete choice on the market today. Fits ⅛" copper tubing and up to 6" iron pipe.

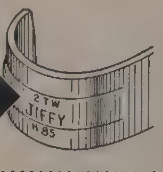
MINERALLAC HEAVY DUTY AND MEDIUM CLIPS
Made of heavier material. Has exclusive inverted rib, that provides more strength at the bend of clip . . . and, of course, adds the benefits of famous "Snap-On" feature. Heavy-duty clips available in aluminum.

MINERALLAC MIN-E SNAP-ON CLIPS
Made of zinc plated steel. Available in ½", ¾" and 1" T.W. Also used for ½" and ¾" rigid conduit or pipe and ⅜", ½" and ¾" flexible conduit. Exclusive "Snap-On" feature.

MINERALLAC STANDARD JIFFY CLIPS
Another Minerallac "Original." Expert design and controlled manufacture have made Minerallac Standard Jiffy Clips the preference of the electrical industry for many years. These standard clips, are available in Steel and Everdur for hanging tubing, pipe, conduit and BX cable. Copper plated also available.

Exclusive Feature!
Each Minerallac fitting is "SIZE-MARKED". All are clearly and individually stamped with its exact size for immediate identification and quick and easy handling. Ends time-consuming guesswork and costly mismatches in the stock room and on the job.

WHEN IT'S
"SIZE-MARKED"
YOU CAN
BE SURE!



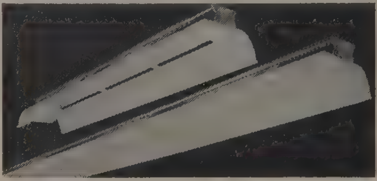
Order from Your Electrical Wholesaler
LITERATURE OR SAMPLE ON REQUEST

MINERALLAC Electric COMPANY
ESTABLISHED 1894
25 N. PEORIA STREET • CHICAGO 7, ILLINOIS

Troughs **(38)**

A new line of socket-breaker troughs for indoor metering of housing projects, apartments, hospitals and other commercial and industrial installations. Troughs are designed in three sectionalized units consisting of socket-breaker trough, load trough and line trough. Units are factory bussed, ready to be mounted and connected. They are UL listed from two to six positions and are available in one complete assembly, ganged up to 18 positions. Each meter position is rated at 100 amps, 120-240 volts ac. Each breaker position will accept a 2-pole plug-in type breaker up to 100-amp capacity and contains the "non-interchangeable rating" feature.

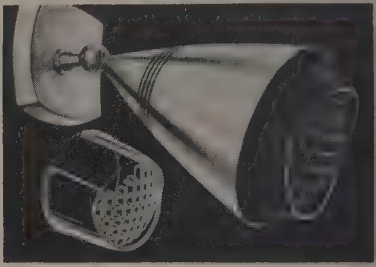
Superior Switchboard & Devices Co., 410 Schroyer Ave., S. W., Canton 1, Ohio



Fixtures **(39)**

The new Dynalite industrial fixtures have been designed to meet the need for high-intensity illumination in industrial plants. The fixtures are available with 25% upward lighting component, 10% upward component and completely enclosed white top reflectors. A constant flow of air through the apertures reduces the operating temperature of the fixture, increasing lamp and ballast life. They are available for two or three lamps in 4- or 8-ft lengths. Ballasts can be supplied for rapid start, pre-heat, power groove, VHO and high-output lamps. Reflectors can be supplied with baked enamel or porcelain enamel finish. Fixture channels made for sliding clamp hangers for installation.

Mitchell Lighting Division, Compco Corp., 1800 N. Spaulding Ave., Chicago 47, Ill.



Floodlight Louver **(40)**

A new design floodlight louver is engineered for positive 45° cutoff in any direction to completely conceal lamp brightness from view. The full-shielded louver fits in all Stonco decorative outdoor bullets using any standard PAR-38 or R-40 medium base reflector lamp, and is precision die-cast in one deep-contoured piece to provide ample open-air space for lamp cooling.

Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J.

Lighting Fixture **(41)**

A new round recessed "Hi-Hat" lighting fixture features a hand blown opal glass diffuser without metal trim. Called the "Glass-Lite," the fully enclosed glass bowl is flared sharply outward and around to cover the entire aperture opening. It is also ideal for outdoor use. Unit is available in three lamp sizes: 75-watt "A" lamp, 100-watt "A" lamp, and 150-watt "A" lamp. The 150-watt unit is equipped with a built-in Chromzak reflector for directional lighting. All three sizes feature the patented "T-N-T" mounting.

Markstone Mfg. Co., 1531 North Kingsbury, Chicago 22, Ill.

Bell Signals (42)

The new Valubel line of single stroke and vibrating bells are made for both indoor and outdoor service. All contain the same ringing mechanism that is adaptable to 4-, 6-, 8- and 10-in. bell shells. Housings are cast metal. The indoor model housing features an adapter plate 4½ in. sq with slots for attachment on standard 2- and 4-in. sq octagonal utility outlet boxes. It can also be mounted to single and double gang plaster rings. Single stroke bells are available for use on ac or dc; vibrating bells on ac only.

Wheelock Signals, Inc., 273 Branchport Ave., Long Branch, N. J.

Range Hood (43)

The 94 Series range hood gives horizontal or vertical air discharge. Hood is completely self-contained and pre-wired. Finished in copper or satin chrome, hood is available in 24-, 30-, 36- and 42-in. lengths to fit into any construction. It has push-type switches, fan, built-in light and packed complete with gasketed duct flange.

Fasco Industries, Inc., Rochester 2, N. Y.

Bar Hangers (44)

Newly improved Type "SX" expandable bar hangers and bar hanger sets have been announced. They are made in two types. The "Economy" Clip-Type bar has a self-centering clip held in with a captive screw. The knockout hole of outlet box is slid over slip and tightened. The Stud-Type bar has a positive-locking, two-piece ⅜ in. fixture stud which attaches through the knockout hole. Either clip or stud may be set at any position over the full length of bar hanger. Two different adjustable lengths are available in both types of bar hangers 14 to 18 in. and 18 to 26 in. Bulletin TOB-161 is available.

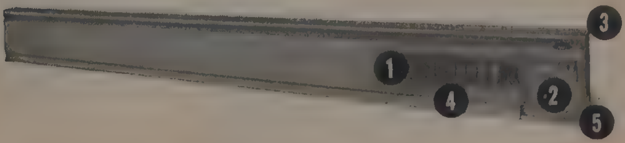
Appleton Electric Co., 1701 Wellington Ave., Chicago 13, Ill.

I'VE SEEN IT—
YOU'LL LIKE
THIS NEW LINE

Ollie Windhorst, owner, Reddy Electric Co., Inc., Louisville, Kentucky

General Electric's new "square silhouette" baseboard heaters with standard thermal cut-out.

Attractive "square silhouette" baseboard heaters head the list of pacesetting all-new electric comfort heating equipment—designed, engineered and *manufactured* by General Electric. Safe linear thermal cut-out is standard equipment on *all* models. The dependable General Electric Calrod® heating unit is equipped with radiating fins for fast heat recovery.



INSTALLATION IS EASY: (1) heating element requires no disassembly, (2) wiring connections are easily accessible *in front,* (3) all covers, end caps and corner pieces snap into place, (4) ample space along raceways for wiring and interconnecting heaters, and (5) sections are easily joined at either end.

FREE LITERATURE: for complete details and specifications, write 49-113-1, General Electric Company, Electric Comfort Heating Section, Appliance Park, Louisville 1, Kentucky.

280-02

Progress Is Our Most Important Product

GENERAL ELECTRIC

Another ARROW CONDUIT
EXCLUSIVE!

ARO-GARD*
PROTECTIVE COATING
TRADE MARK

KEEPS CONCRETE OUT
OF TAPPED HOLES
IN CONCRETE RINGS

* Pat. Pending

Now, one more of your big costly installation problems is eliminated... no more wasted time in cleaning concrete out of tapped holes! "ARO-GARD", Arrow Conduit's new protective plastic compound, covers tapped holes during manufacturing process. "ARO-GARD" is hard enough to keep concrete out of tapped holes —yet soft enough to allow screw to penetrate protective film with ease.

"ARO-GARD" is easily identified by green color (see shaded area in illus.). Now available on all Arrow Conduit Concrete Rings, at NO ADDITIONAL COST TO YOU.

Write for samples and data of "ARO-GARD" application process.

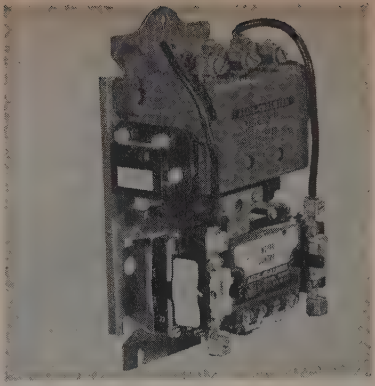
New Products from Arrow Conduit help you keep pace with modern wiring needs.

OUTLET BOXES • GANG BOXES • COVERS • BOX SUPPORTS

ARROW CONDUIT
& FITTINGS CORP.
108–20 180th Street, Jamaica 33, N. Y.

ARROW CONDUIT & FITTINGS CORP

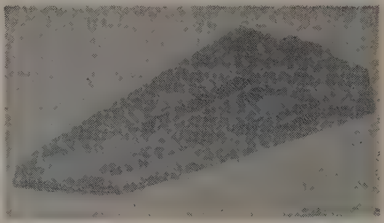
Sales Representatives & *Warehouse Stocks *ATLANTA, GA. • BALTIMORE, MD • *BIRMINGHAM, ALA • *CHICAGO, ILL • *CINCINNATI 37, OHIO • DALLAS, TEXAS • *DETROIT 2, MICH • GREENSBORO, N.C • *LOS ANGELES, CALIF • *MIAMI, FLORIDA • *NEW ORLEANS, LA. • NEW YORK CITY, N. Y. • NEWTON CENTRE, MASS • *PHILA., PA. • RICHMOND, VA. • ROCHESTER, N.Y. • SEATTLE, WASH. • ST. LOUIS, MO



Starter **(45)**

Redesign of size 2 ac magnetic full-voltage starter to provide greater compactness and dc operation has been announced. The new starter has thermal setting, phenolic arc chamber. Stationary and movable contacts are of silver cadmium oxide. The epoxy encapsulated 110/220 and 220/440 dual voltage and 550 single voltage coils are inherently moisture and fungus proof. Also color-coded for identification. Trip-free bi-metallic overload relays and heaters are available with a complete selection of heater elements. Starter is available in 2-, 3- or 4-pole configurations.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.



Luminaires **(46)**

A new line of fluorescent luminaires for use in classrooms, called the Triumph line, can be supplied in a variety of side panels, shieldings, and sizes. Side panels of either metal or double-walled luminous plastic are available. Choice of shielding includes 35° by 45° metal louvers, 35° by 25° metal louvers and Opti-Kube prismatic shielding. Triumph units come in 2- or 4-lamp widths and 4- or 8-ft lengths. Luminaires have been designed for mounting with standard hangers, but they can be adapted for surface mounting since a solid top panel is available. A perforated top panel can be supplied for installations where luminaires will be mounted close to a ceiling. Lamps rated at either 425 or 800 ma can be used with the units. They are also well suited for libraries, offices, banks and retail stores.

Westinghouse Electric Corp., Lighting Division, Edgewater Park, Cleveland, Ohio

Load Center **(47)**

A new line of 3-phase, 4-wire "Twin" load centers, featuring completely sequence phased bussing, has been announced. All G-E circuit breakers may be plugged in anywhere on the extra wide, sequence phased bus. In addition, single- and two-pole breakers may be installed directly opposite G-E's new 100-amp TQAL plug-in breaker, now standard with lugs suitable for copper or aluminum wire. The new UL listed panels are rated 120/240 and 120/208Y volts ac, 3-phase, 4-wire, and 240 volts, 3-phase, 3-wire. All are main lugs-only devices with lugs approved for use with either copper or aluminum conductors.

General Electric Co., Circuit Protective Devices Dept., Plainville, Conn.

Sealing Connections **(48)**

A new method of sealing underground direct-burial cable connections has been developed. The device, named "Splicap," provides a moisture tight, foolproof seal. It consists of five plastic sections. Threaded to fit into each other, two are used on each end of the splice and these two in turn are connected by the other threaded section. The moisture proofing is accomplished through the use of a neoprene "O" ring around the wire between the two plastic connectors. "Splicap" is inserted over the open ends of the wire before the splice is made. It is made to fit cable sizes Nos. 2 and 14.

Western Plastic Company, Hastings, Nebr.

You get more value for the same dollar—in the NEW Bulletin 709 line of starters!

A-B
QUALITY

This new line of Allen-Bradley motor control will change every idea you have had about starter size, performance, and life. The small size—especially in the higher ratings—is startling. Yet rating for rating the operating life and reliability have been increased many times. Built into each of the seven sizes of this new Allen-Bradley line is an ability to interrupt tremendous currents and to operate year in and year out for many millions of operations without trouble or maintenance.

The new Bulletin 709 starters are just as advanced in appearance as they are in performance. All seven sizes have an aristocratic styling and a distinctive family likeness. Brooks Stevens, famous industrial designer, has given the enclosures such an attractive, modern style that these new starters will prove a distinct sales asset on any machine or installation.

Why not write today for more information on this revolutionary new line of Allen-Bradley Bulletin 709 *quality* across-the-line motor starters?

Note the compactness of both the smallest and largest starter in the new Bulletin 709 line. Ratings up to 100 hp, 220 v; 200 hp, 440-550 v.

10-61-RM

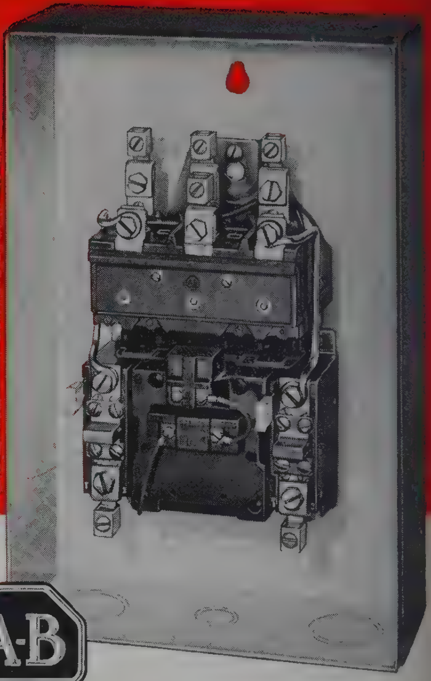
ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

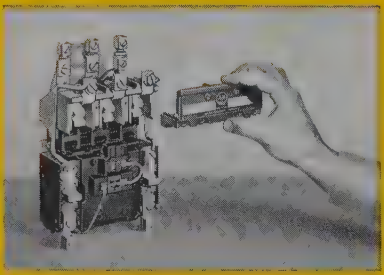
QUALITY
MOTOR
CONTROL

Features of the NEW Allen-Bradley starter line that are of value to you!

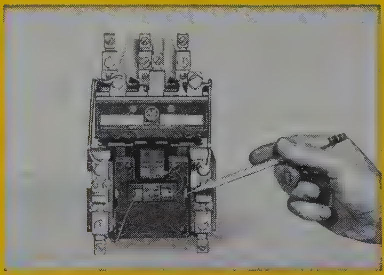


New Bulletin 709 Size 3 across-the-line motor starter. Note the generous space for wiring, accessible terminals, and white interior.

Every detail of the new Allen-Bradley motor starters has been designed to help make this the best line of motor control on the market. Remarkably small in size, each starter is a giant in performance. Being light in weight, these starters are easy to handle and a cinch to install. The generous wiring space, full front wiring, white interiors, and convenient knockouts make installation easy. The enclosure cover is firmly held with a quarter-turn fastener. All installation, inspection, and maintenance operations can be handled from the front—as shown in the illustrations below—without the use of special tools.



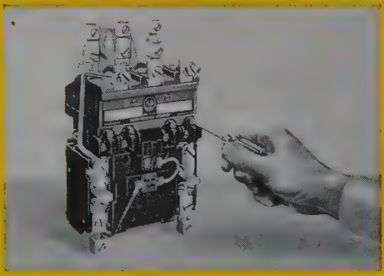
QUICK, EASY CONTACT INSPECTION—When the arc hood front cover is removed by loosening two captive screws, contacts are plainly visible from the front.



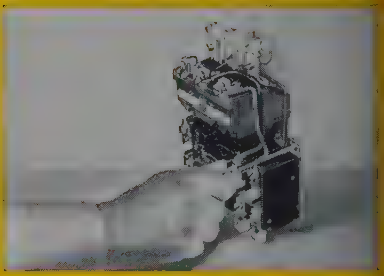
CONTACT POSITION INDICATED—Two slots in the coil cover show the position of the movable contact support—tell whether contacts are "closed" or "open."

CONTACTS EASILY REPLACED—Depress the spring slightly, and the movable contacts can be lifted out of the molded support and the new contacts slipped in.

COIL EASILY CHANGED—When the coil cover is removed, coil and magnet yoke can be lifted out from the front. They are impossible to replace incorrectly.



AUXILIARY CONTACTS EASILY ADDED to the front of the starter. Two extra auxiliaries can be added to Sizes 0, 1, and 2 starters, and four, to Sizes 3, 4, and 5.



A THIRD OVERLOAD RELAY CAN BE EASILY ADDED in the field, from the front of the starter. And the only tool needed is a common screwdriver.

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

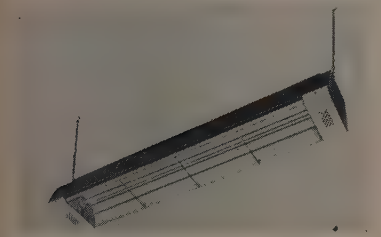
QUALITY MOTOR CONTROL

10-61-RM

Pushbutton Station **(49)**

A two-unit toggle type explosion-proof pushbutton station has been added to this line. Housed in an all-aluminum enclosure, preventing corrosion and sparking, this device was designed to meet NEMA 7 and 9 specifications. Primary use is for motor control in a hazardous area. Station can be provided with either maintained 2- or 3- position contacts or momentary 2-position contacts. A maximum of two contacts in either position can be provided with any arrangement of normally opened or closed.

Gemco Electric Co., 25685 *West Eight Mile Road, Detroit* 40, *Mich.*



Heating Unit **(50)**

A new "Quartz-Ray" infrared unit for spot area heating indoors or outdoors. Unit looks like a flourescent lamp, hung from the ceiling. It may be plugged into any socket. Seven models are available: 1000-, 1500-, 2000-, 3000-, and 4000-watt sizes. The 1000- and 1500-watt sizes are available in 120 and 240 volts, the others, 208 or 240 volts. All are listed by UL.

Seaboard Products Corp., 191-3 *Frelinghuysen Ave., Newark* 8, *N. J.*

Lamp **(51)**

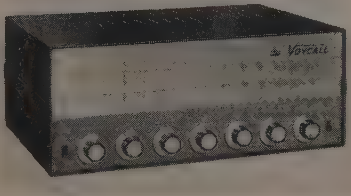
A new fluorescent light source, called "panel fluorescent lamp," is 12 in. square and about 1½ in. deep. Using a rapid start circuit, it has a rated life of 7500 hours, produces 4800 lumens initially at 80 watts input, or 2900 lumens initially at 50 watts input. Light distribution is 50% from face, 50% from back. Face of lamp is of unique modular configuration while back of lamp reveals 60-in. tube configuration for mercury vapor arc path. Panel fluorescent lamps will be available initially in cool white, and in deluxe white colors later.

General Electric Company, Nela Park, Cleveland, Ohio.

Transformers **(52)**

New single-lamp and 2-lamp mercury transformers especially designed for high ambient temperatures are for use in industrial areas. Class B insulation and special capacitors insure operation in ambient temperatures up to 55°C. Constant wattage principle is a standard feature. Primary current drops when an open or short-circuit condition occurs in the lamp circuit.

Sola Electric Co., Busse and Lunt, Elk Grove Village, Ill.



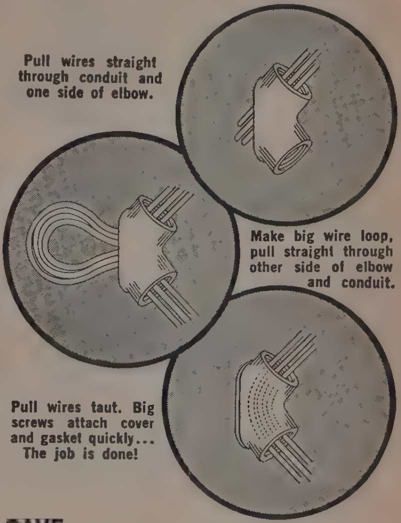
Amplifiers **(53)**

An all new 18, 35, and 70 series of commercial audio amplifiers have been announced. The 18-, 35- or 70-watt power is available with a wide variety of internal pre-amp control panels. Separate tone controls for music and speech, up to four microphone inputs. All three power units and all pre-amp control variations are designed to be interchangeable. The Voycall amplifiers are recommended for use in airports, auditoriums, bus and railroad terminals, etc.

Lake Manufacturing Co., 2323 *Chestnut St., Oakland* 7, *Calif.*

IDEAL PULLING ELBOWS

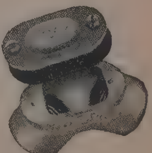
make wiring around corners this easy . . .


Pull wires straight through conduit and one side of elbow.
Make big wire loop, pull straight through other side of elbow and conduit.
Pull wires taut. Big screws attach cover and gasket quickly... The job is done!

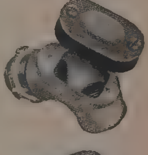
SAVE WIRING TIME—AND WIRE

Precision machined and milled Ideal Pulling Elbows and Pulling Adapters guide your wire around a perfect 90° angle — smoothly, easily and without wear. Sturdy malleable iron body will not break or crack. Cadmium plating and chromate treating resist corrosion. Steel covers—domed for greater strength—are easily removed for wire installation and inspection, and full neoprene gasket assures tight fit.

PNF TYPE PULLING ELBOW
Two female threaded hubs at 90° angle. Domed cover, full gasket. Sizes ½" through 2".



PNH TYPE PULLING ADAPTER
Two hubs, one female threaded, one male threaded, at 90° angle. Domed cover, full gasket. Sizes ½" through 2".

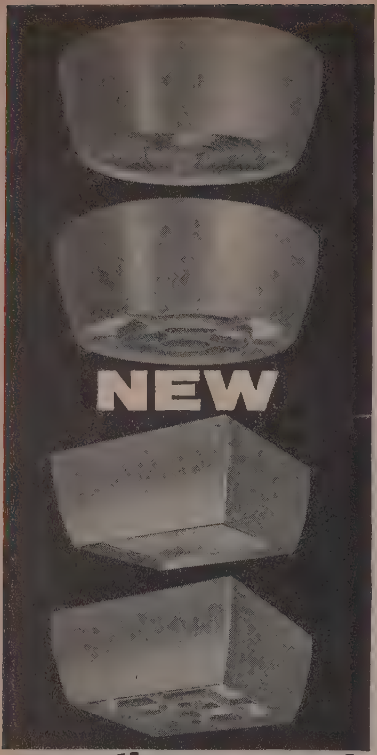


"L" TYPE PULLING ELBOW
Two female threaded hubs at 90° angle. Swing style steel cover attached to maleable iron body. Angular opening permits straight wire pull. Furnished with gaskets. Sizes: ½", ¾" and 1", threaded.

IDEAL

SEE YOUR WHOLESALER, OR MAIL THIS COUPON. Attach to your letterhead.

IDEAL INDUSTRIES, Inc.
1041-F Park Ave., Sycamore, Illinois
Please send complete data on Ideal Pulling Elbows and Adapters.
Name ____________
Address ____________



weather-proof everlasting protected lighting

square **82-84** round

lines

by mc Philben

Exterior and interior ceiling surface applications under CANOPIES, MARQUES, in SHOWER ROOMS, CORRIDORS, VESTIBULES, ALL PURPOSE ROOMS, LOBBIES, SHOPPING CENTERS. Absolute security application in PSYCHIATRIC HOSPITALS, PRISON CELLS, CHILDREN SHELTERS.

82 and 84 lines feature:

- ALL CAST ALUMINUM, sturdy, 2 piece construction in both guarded and non guarded units with integral cast hinge. Extra heavy .156 inch wall thickness.
- VAPORTIGHT (enclosed and gasketed), BUGTIGHT, WEATHERPROOF performance.
- mcPhilben's EVERLASTING ANODIZED satin aluminum finish, for permanent protection against corrosive elements.
- CHOICE of diffusers: Holophane prismatic Controlens,® tempered Fresnel Lens, heavy molded Carrara glass, or Herculite (for high security applications)

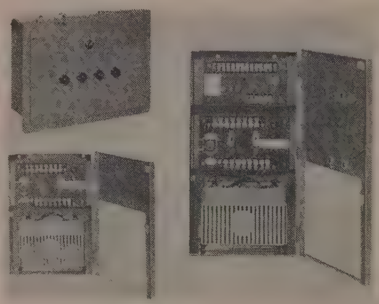
Complete specification data sheets on request Section A pages 9-10/9a-10a

mc Philben
LIGHTING
1329 Willoughby Ave., Brooklyn 37, N. Y.

Disconnect Switches (54)

Continuous current ratings of Loadbuster disconnect switches have been raised from 400 to 600 amps. This new rating basis provides an overload capability on all 400-amp units now in service and allows for future system growth. The 15-kv Loadbuster disconnect switches come in 95-kv and 110-kv BIL ratings to cover most distribution system applications. The disconnect carries a short-time rating of 25,000 amps (momentary) and 16,000 amps. (4-second).

S&C Electric Company, 4435 N. Ravenswood, Chicago 40, Ill.



Fire Alarm Cabinet (55)

A new automatic fire alarm control cabinet has been announced. Basic compact unit monitors one circuit with a local alarm only. It draws its power from a 120-volt ac line and converts it to 6-volt dc for actual operation. Upon an ac power failure cabinet sounds a trouble alarm and automatically transfers to self-contained battery operation. To basic units, a four-zone annunciator panel may be added which can be flush or surface mounted. Any number of detectors and non-code breakglass stations can be used with the panel, and a locking type alarm relay permits use of self-restoring detectors or stations. All are UL listed. Data Sheet K-23 is available.

Kidde Ultrasonic & Detection Alarms Div., Walter Kidde & Company, Inc., Clifton, N. J.

Product Briefs

(56) A new light-weight portable **trencher** which weighs 345 lbs and will dig a trench 3 in. wide with any depth to 32 in. is being marketed under the name of Digz-All by the Wind-King Mfg. Co., Merrill, Ia. . . . (57) The Chalfant Products Co., Inc., Cleveland, Ohio, has announced newly designed **splice plates,** having special crimping slots on each end.

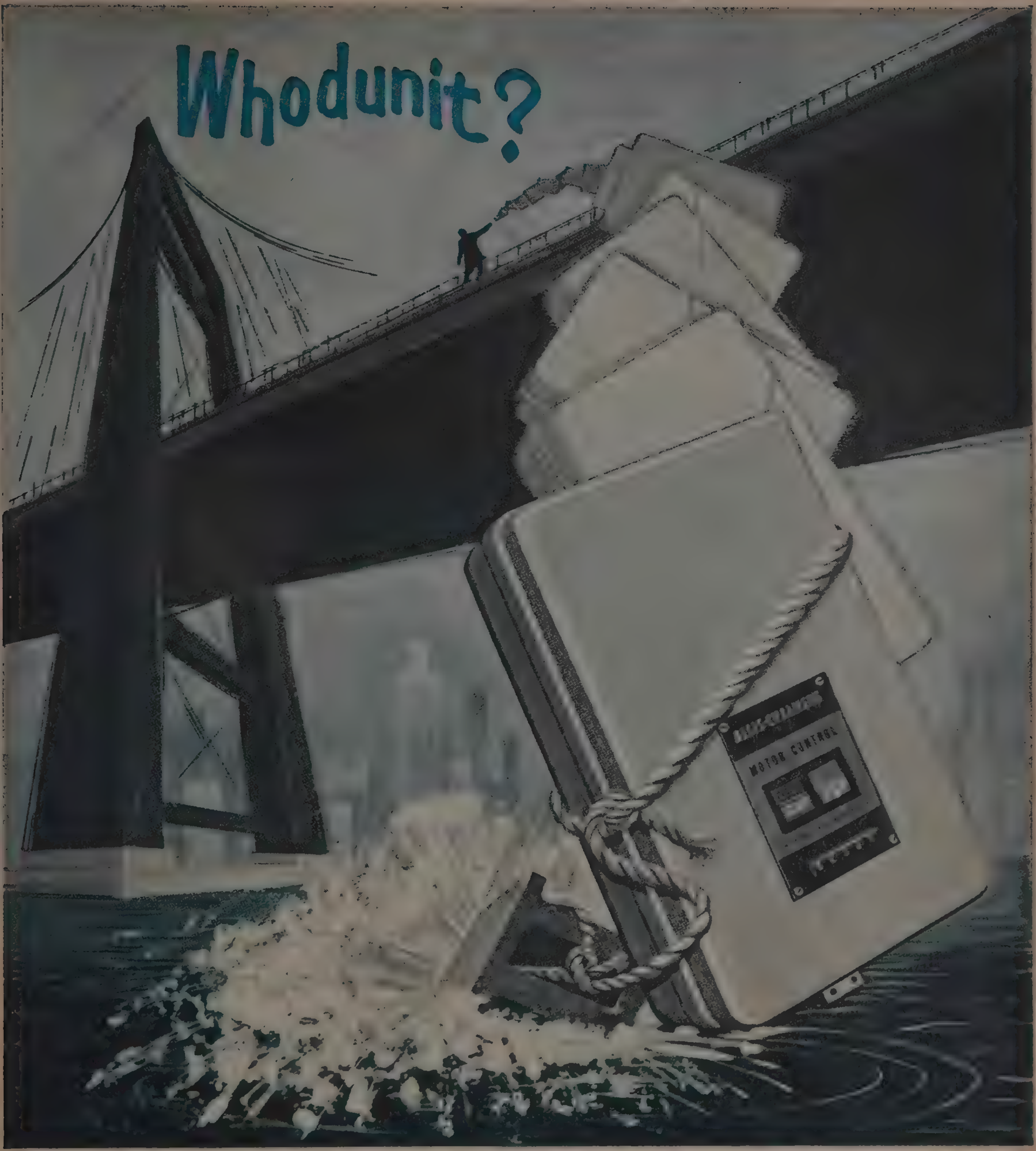
(58) A standard malleable iron **bushing** capped from the inside with a water resistant paper penny for use with rigid conduit is available from the Electrical Fittings Corp., Woodside, N. Y. . . . (59) The Westinghouse Electric Corp., Bridgeport, Conn., has developed a new line of heavy-duty plastic wall **switch plates** called "Decorator Wall Plates."

(60) A line of compact, cast aluminum explosion-proof control station **boxes,** switches and pilot lights complete with device legend plates for flush panel mounting is announced by The Adalet Mfg. Co., Cleveland, Ohio. . . . (61) The Bryant Electric Co., Bridgeport, Conn., has announced new plastic **wall plates** named "Smooth-Line."

(62) All hangers, clips, straps and beam **clamps** produced by the Minerallac Electric Co., Chicago, Ill., are now clearly and individually stamped with exact sizes . . . (63) General Electric Co., Cleveland, Ohio, has announced development of two sizes of Quartzline incandescent **lamps** in 500-watt, 120-volt and 1500-watt, 240-volt sizes, designed especially for "rough service" applications.

(64) A new automatic emergency **lighting unit,** capable of illuminating 10,000 to 25,000 sq ft continuously for 3 to 8 hours or more, has been introduced by Exide Industrial Marketing Div., The Electric Storage Battery Co., Philadelphia, Pa. . . . (65) Industrial Products Co., Philadelphia, Pa., has introduced a new lightweight multiple **lockout** for electric switch and fuse boxes.

(66) A complete selection of **connectors** for flexible cords and cables is now being produced by Killark Electric Mfg. Co., St. Louis, Mo. . . . (67) Auto Crane Co., Tulsa, Okla., has announced a new line of battery powered material handling **cranes** designed for one-man handling of poles, transformers, signs, and other heavy items which require long boom handling.



Recently our Manager of Renewal Parts Sales threatened to throw our entire line of modern, compact, easily-maintained, quickly-modified, low-voltage motor controls into the drink. Why? Because it's running him out of business! He doesn't sell a fourth of the replacement parts he used to.

Two years ago, when our engineers designed the bulk out of the Allis-Chalmers low-voltage motor control, they built simplicity into it. And with simplicity came outstanding reliability. Our nation-wide stocks of replacement parts are gathering dust. And warranty returns are negligible.

These controls don't work under water, of course. But they do perform faithfully under practically any other conditions. And they're *still* the most advanced control design in the industry. All sizes from 00 to 9 are available from your A-C distributor. *See him for more facts or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.*

A-1485

ALLIS-CHALMERS A-C

only **ONE** plier gives you **BOTH**

THESE POWER-GRIP FEATURES

Machined, Undercut Channels. Smooth working, can't slip under any load!
Reinforcing flange for added strength where you need it!
CHAMPION DEARMENT MEADVILLE, PA. U.S.A.
CHAN NEL LOCK
No 420

CHAN NEL LOCK®

Only CHANNELLOCK gives you these power-grip features. That's why thousands of skilled mechanics—year in, year out—buy CHANNELLOCK in preference to any other plier. They prefer its terrific gripping power, its all 'round usefulness. And you will, too! Available in three jaw capacities: ⅞", 1½" and 2". Ask your tool supplier for a *genuine* CHANNELLOCK Plier. If he's out of them, ask him to order one for you.

Write for Catalog of Complete Line of Pliers

CHAMPION DEARMENT TOOL COMPANY
MEADVILLE 6, PENNSYLVANIA

Catalogs & Bulletins

(68) VERTICAL MOTORS. 2-page Bulletin 1485 contains application information and mechanical features of integral-horsepower vertical motors. Century Electric Co.

(69) AC BRAKE. Bulletin GEA-1518D, 4 pages, discusses use of Thrustor and solenoid-operated spring-set two-shoe brakes. General Electric Co.

(70) ELECTRIC HEATING. 6-page publication describes application of electric heating to the Comfort Curtain system of classroom heating. Lennox Industries Inc.

(71) FLUORESCENT LAMPS. "New Light, More Light" describes new line of high efficiency fluorescent lamps. Westinghouse Electric Corp., Lamp Div.

(72) CURRENT LIMITING FUSES. Bulletin GEA-6319D, 8 pages, describes application, operation and features of Class J, H, and L current limiting fuses used for short-circuit and overcurrent protection of industrial plant and commercial building applications. General Electric Co.

(73) PLASTICS FOR LIGHTING is title of new lighting report giving physical properties of lighting fixtures with plastic lenses. Holophane Co., Inc.

(74) U-BOLT CLAMPS. 4-page data Folder 6101 describes aluminum U-Bolt clamps for electrical conductors. Jasper Blackburn Corp.

(75) LAMP BALLASTS. 6-page Bulletin GEA-7119A contains tables of prices and data on line of fluorescent lamp ballasts for outdoor applications. General Electric Co.

(76) CONTROLLER. 8-page Instrument Section No. 52 describes new "Thermo Electronic" multi-point controller. Thermo Electric Co., Inc.

(77) FANS AND HEATERS. 8-page Sweets Bulletin DB7-102 describes direct-connected airfoil centrifugal fans, propeller and centrifugal power roof ventilators, wall-mounted and square-panel propeller fans, and steam, hot water, electric and gas-fired unit heaters. Ilg Electric Ventilating Co.

(78) REGULATORS. "The ABC's of Regulators," Bulletin 61052, is an

elementary treatise on single-phase, 32-step distribution regulators. Line Material Industries, McGraw-Edison Co.

(79) CIRCUIT BREAKERS. A color-coded catalog describes circuit breakers available. Mears Controls, Inc.

(80) ELECTRICAL ENCLOSURES are described in revised bound catalog. Machinery Electrification, Inc.

(81) OUTLET BOXES, covers, and box supports are listed in new illustrated price book. Arrow Conduit & Fittings Corp.

(82) HEATING RACK Bulletin 103-T describes new series of "folded and formed" industrial electric heating units for furnaces, ovens and dryers. Trent, Inc.

(83) PRECISION SWITCHES. 20-page Catalog 104 covers a representative selection of products from line of precision switches for industrial, commercial, data processing, airborne and electronic applications. Micro Switch

(84) HOSPITAL LIGHTING guide, 24 pages, contains recommended lighting levels for 112 specific areas in the modern hospital. Day-Brite Lighting, Inc.

(85) INCANDESCENT LIGHTING. Two catalog supplements numbered 61A and 61B illustrate different groups of incandescent lighting fixture originals for home, commercial and industrial use. Jay Lighting Mfg. Co., Inc.

(86) RECORDERS. Bulletin GEZ-3316, 4 pages, describes type HF strip recorders and HR round-chart recorders for use in recording and indicating any deviations from a predetermined frequency. General Electric Co.

(87) PRECISION SWITCHES for control and indicating circuits are described in 32-page Catalog 10-1. Unimax Switch Div., W. L. Maxson Corp.

(88) PROTECTIVE PRODUCTS. 8-page Booklet EHV-200 entitled "Planned Line Protection for EHV" highlights a package of protective products and correlated programs of laboratory and field testing for power projects transmitting extra high voltages. Preformed Line Products Co.

(89) NAIL-ANCHORS. How to save time fastening fixtures to all kinds of masonry with one-piece nail-anchors is explained in new folder. The Rawlplug Co., Inc.

NEW prismatic luminaire — maximum light, minimum glare ►
◄ NEW opal series — for soft, diffused lighting.
◄ NEW bullet beauty — for decorati outdoor floodlighting.
NEW underwater lights — for swimming pools, fountains. ►
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MORE BEAUTY IN OUTDOOR LIGHTING

Open up new decorative possibilities outdoors, indoors with these contemporary definite-purpose fixtures from Stonco. All precision die-cast aluminum or solid cast bronze. All engineered to keep their good looks through daily punishing wear and tear in exposed locations. Write for specification catalog S-61. **Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N.J.**

STONCO lighting

- CLUSTER LIGHTS
- POWER-BEAMS
- VAPORTIGHT
- MERCURY VAPOR
- BOXES and FITTINGS
- EMERGENCY PORTABLES

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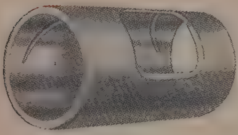
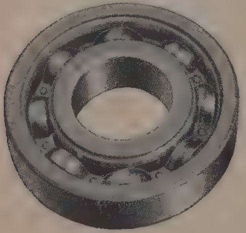
Wagner® Replacement Bearings DO help you make faster, better motor repairs.

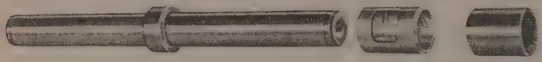


WAGNER® SLEEVE BEARINGS fit right every time because they are exact duplicates of the original bearings used in Wagner motors. Steel-backed and 85% tin babbitt-lined, they are precision bored to size . . . won't seize or grab, won't corrode.

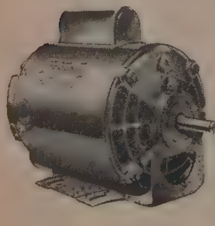


WAGNER® BALL BEARINGS are exactly right for the motor in which they're used. They are the same high quality bearings used in new Wagner motors . . . the finest money can buy.

SLEEVE BEARING REPLACEMENT IS EASY WITH THE WAGNER® BEARING TOOL



This time-saver lets you drive out the worn bearing and install a new Wagner sleeve bearing in a single, easy operation. No pounding or reaming is necessary . . . you get perfect alignment every time.



P. S. ***If the motor isn't worth repairing, sell a new Wagner® motor.*** There are times when it just doesn't pay to repair an old motor. That's the time to replace worn-out motors with new Wagner motors. You remove any doubt about making a profit on repairing a badly worn motor, and save time for other repair work. Best of all, you make full profit on every Wagner motor sale, plus giving your customers over-the-counter service. See your Wagner distributor . . . learn how easy it is to cash in on motor replacement sales.

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6413 PLYMOUTH AVENUE, ST. LOUIS 33, MO., U.S.A.
OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS
WR61-4
MOTORS • BEARINGS • STANDARD ROTORS • BRUSHES • CAPACITORS • COMMUTATORS

(90) AIR CONDITIONING. Form LL-471 lists specifications for 20 new models, and includes a room air conditioner selection guide. Chrysler Corp., Airtemp Div.

(91) GENERATORS. "Factors to be Considered When Installing Emergency Generators" is the title of 4-page folder which covers every phase of planning and engineering prior to the actual installation of the unit. Onan Div., Studebaker-Packard Corp.

(92) FAULT INDICATORS are illustrated in Bulletin SP3 including ordering and dimensional information. Line Material Industries, McGraw-Edison Co.

(93) LOAD CONTROL SYSTEMS. Bulletin GET-2916B, 4-page revision, describes load control systems for industrial plants which generate all or a part of their electrical requirements. General Electric Co.

(94) STRIP HEATERS. Descriptions, illustrations and selection procedures for line of general purpose and finned-type strip heaters are provided in 12-page Catalog C-300. Bryant Electric Co.

(95) POWER SUPPLY. 8-page Bulletin DCX-361A describes new CVQ transistorized dc power supply. Sola Electric Co.

(96) SUMP PUMP MOTORS. Bulletin GEA-6687A, 6 pages, describes sump pump motors, ⅓ hp, 1725 rpm, in both standard and deluxe models. General Electric Co.

(97) POWER TOOLS and their accessories are described in 68-page catalog. Skil Corp.

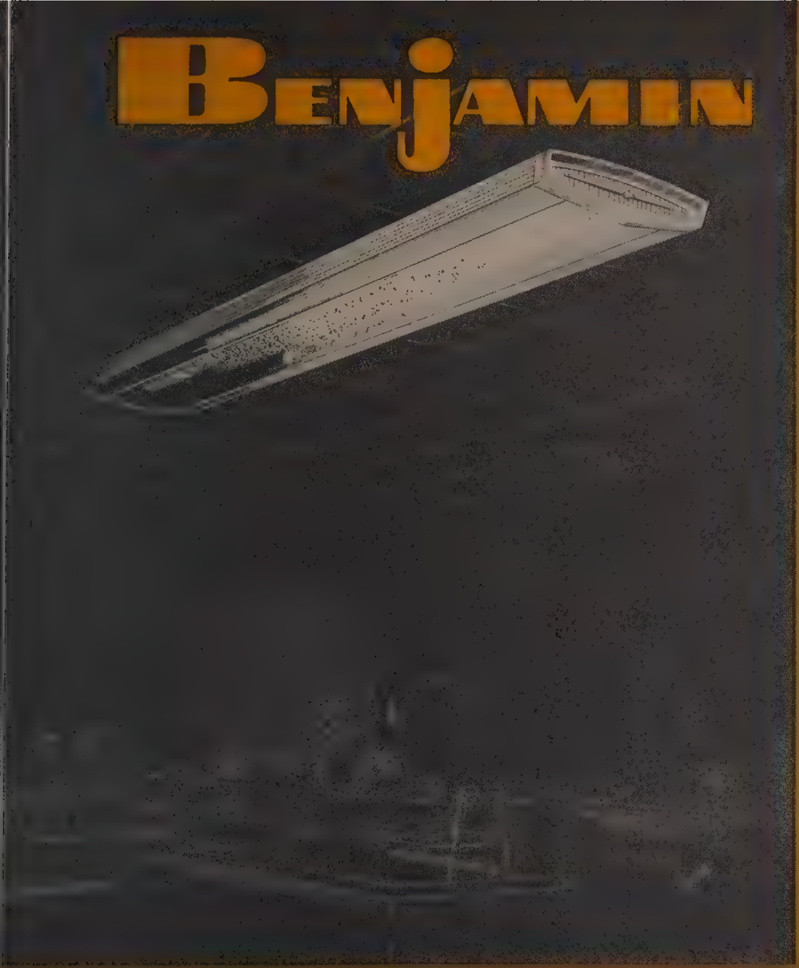
(98) FLUORESCENT BALLASTS. 4-page Bulletin GEA-6912 features new Bonus Line fluorescent lamp ballasts. General Electric Co.

(99) RESISTORS. Close tolerance power wire-wound resistors are described in Bulletin P-8. International Resistance Co.

(100) GRIPS for flexible conduit, cords, caps and connectors, strain relief and pulling are described in 24-page Catalog No. 60. The Kellems Co., Inc.

(101) OUTLET BOXES, covers and box supports are illustrated in price book No. SB-161. Arrolet Corp.

(102) TRANSFORMERS. 4-page Bulletin CVS-3631 describes standard sinusoidal constant voltage transformers. Sola Electric Co.



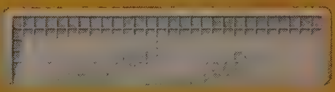
DISCRIMINATING DIMENSIONS IN LIGHTING

We're proud to offer two of the most distinguished designs available in the market today. Benjamin know-how has combined superior engineering and maximum lighting efficiency in smart, slim fluorescent fixtures, that add the note of distinction to any office or commercial installation. Dramatically decorative . . . competently functional.

No visible metal supports. Can be mounted singly or in continuous unbroken line. Variety of light-diffusing lenses for any purpose. Two or four lamp. Forty-eight inch lengths.

The incomparable CORONADO

Here is the latest development in controlled lighting—3 in 1 lens—snap-in wiring channel—only 2½" deep—two types of lens. Designed for surface mounting for all types of commercial lighting—offices, schools, banks and other interiors that require high quality illumination, realistically priced.



The distinctive Catalina

Today's most copied commercial fixture. Its beauty of design and universal adaptability make it the number one choice of architects and consulting engineers. Selected by contractors for its ease of installation. In either prismatic lens or plastic louvers, this unit has no equal.

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The World's Largest Single Source of Lighting
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207 E. Broadway, Louisville 2, Kentucky

☐ Please have your Lighting Specialist call

☐ Please send me your new folders on the Catalina and Coronado

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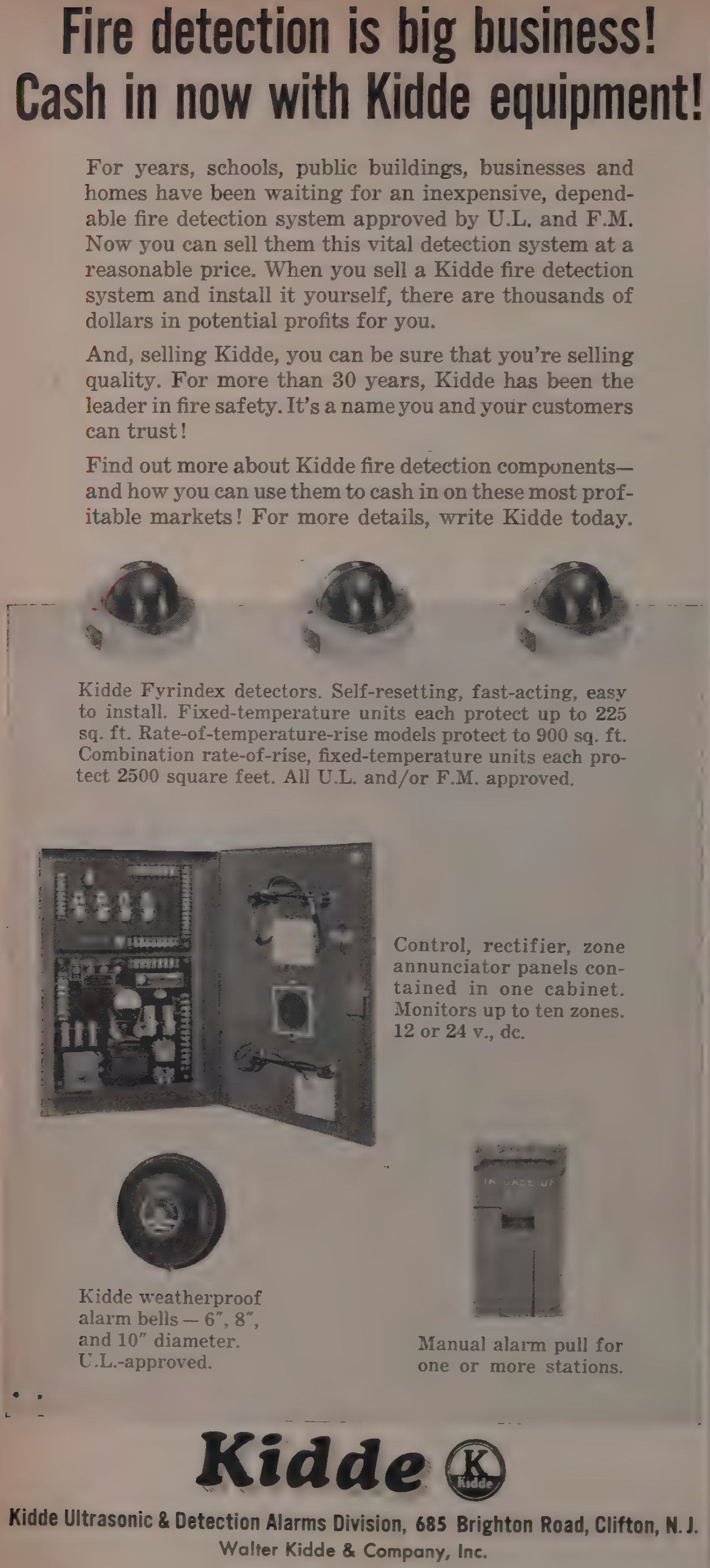


Fire detection is big business! Cash in now with Kidde equipment!

For years, schools, public buildings, businesses and homes have been waiting for an inexpensive, dependable fire detection system approved by U.L. and F.M. Now you can sell them this vital detection system at a reasonable price. When you sell a Kidde fire detection system and install it yourself, there are thousands of dollars in potential profits for you.

And, selling Kidde, you can be sure that you're selling quality. For more than 30 years, Kidde has been the leader in fire safety. It's a name you and your customers can trust!

Find out more about Kidde fire detection components—and how you can use them to cash in on these most profitable markets! For more details, write Kidde today.

Kidde Fyrindex detectors. Self-resetting, fast-acting, easy to install. Fixed-temperature units each protect up to 225 sq. ft. Rate-of-temperature-rise models protect to 900 sq. ft. Combination rate-of-rise, fixed-temperature units each protect 2500 square feet. All U.L. and/or F.M. approved.

Control, rectifier, zone annunciator panels contained in one cabinet. Monitors up to ten zones. 12 or 24 v., dc.

Kidde weatherproof alarm bells — 6″, 8″, and 10″ diameter. U.L.-approved.

Manual alarm pull for one or more stations.

Kidde

Kidde Ultrasonic & Detection Alarms Division, 685 Brighton Road, Clifton, N. J.
Walter Kidde & Company, Inc.

(103) SWITCHBOARD INSTRUMENTS, Types AB-30 and DB-30, are described in Bulletin GEZ-3308, 12 pages. General Electric Co.

(104) FLUORESCENT LIGHTING fixtures are described in Catalog C-161 including four sections covering the "Engineered Line" of specification-type surface-mounted units, a 22-page troffer section, RLM industrial units and economy units. Keystone Electric Mfg. Co.

(105) LOAD CONTROLS. The application of load controls is described in 32-page booklet "Cutting Production Costs with an MEK Load Control." Machinery Electrification, Inc.

(106) LIMIT SWITCHES. Bulletin GEA-7319, 2 pages, describes new CR115B precision snap-action limit switches for highly repetitive operation in limited-space industrial applications. General Electric Co.

(107) ARMATURE WINDER. Bulletin 613AH describes new time-saving double-flier automatic model armature winder. Possis Machine Corp.

(108) AUTOMATION. 22-page Bulletin 611 covers all phases of electric eye applications in automation including illustrations and schematics showing diversified photoelectric systems. Photomation, Inc.

(109) CABLE TRACER. Details of a new Amprobe cable tracer designed to speed tracing of electrical conductors are described in catalog sheet. Pyramid Instrument Corp.

(110) FLUORESCENT LUMINAIRES. Booklet B-7257 tells the advantages of lighting signs with fluorescent luminaires and describes equipment available. Westinghouse Electric Corp., Lighting Div.

(111) WIRING DEVICES. A variety of wiring devices including switches, outlets, receptacle covers, wall plates and lampholders is described in new 8-page catalog C-101. The Bryant Electric Co.

(112) INCANDESCENT LIGHTING. The Endura Series of incandescent lighting fixtures designed for commercial, institutional and residential interiors is described in 16-page catalog. Litecraft Manufacturing Corp.

(113) TRANSFORMERS. Operating and maintenance benefits of the Endur-All distribution transformers are described in Bulletin 61B9943. Allis-Chalmers Mfg. Co.

(114) EPOXY INSULATION. A new Systems Selector for epoxy insula-

tion shows the outstanding properties of selected electrical insulating compounds. Electrical Insulation Div., Hysol Corp.

(115) CABLES insulated with Okonex butyl-base high-voltage insulation are described in 48-page reference manual. The Okonite Co.

(116) SILICONES and their uses are illustrated in new 8-page Catalog CDS-129C. General Electric Co., Silicone Products Dept.

(117) CONTACTORS. Wiring diagrams for the automatic control of mechanically-held contactors and of low-voltage relays are featured in Bulletin No. 80. Tork Time Controls, Inc.

(118) MASONRY-ANCHORING costs are analyzed in 8-page booklet entitled "Install It for Less." The Rawlplug Co., Inc.

(119) ELECTRIC HEATERS. Form No. PC-1245 gives specifications and basic features of electric heaters plus a brief discussion of the advantages of automatic electric heat. Cavalier Corp., Electric Heating Div.

(120) SPEED DRIVES. 112-page variable speed catalog features exclusive "lube-free" integral and fractional horsepower variable speed drives. Sterling Electric Motors, Inc.

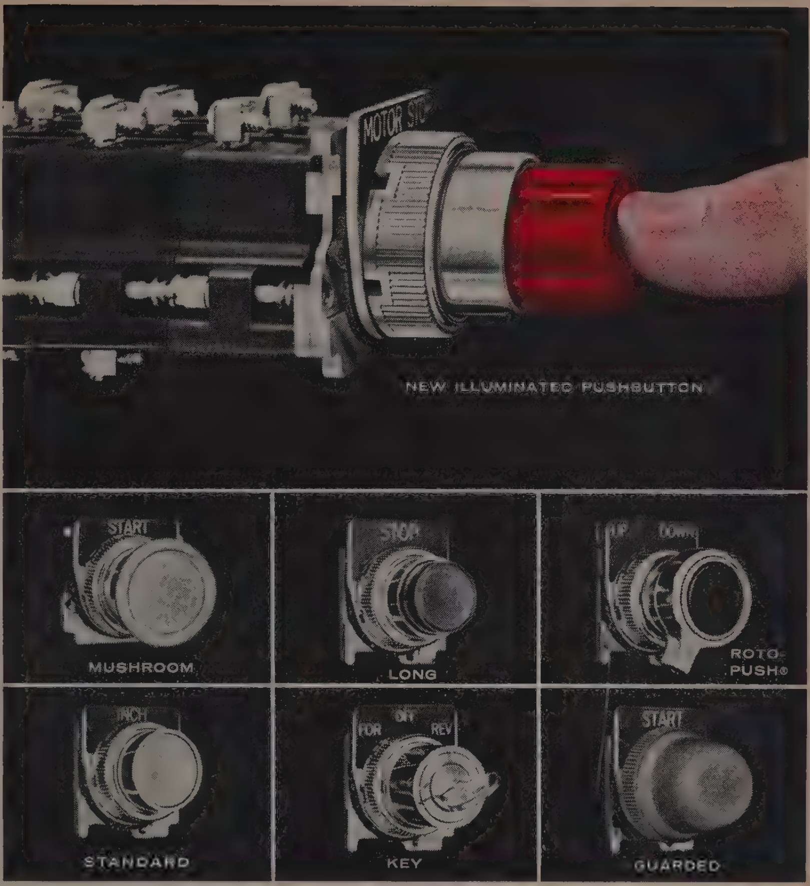
(121) DISTRIBUTION REGULATORS. Bulletin RV2 contains information about overhead-type, single-phase, 32-step distribution voltage regulators, rated 2.5 through 13.8 kv and 25 through 668 amps. Line Material Industries, McGraw-Edison Co.

(122) AC GENERATORS. Publication 2100-PRD-254 describes line of synchronous ac generators rated 187 kva and larger. Electric Machinery Mfg. Co.

(123) INSULATION TESTERS. Bulletin 21-45-6 describes new and improved models of Megger insulation testers. James G. Biddle Co.

(124) TRENCH HEADER. Technical Data No. 1 gives complete details on the new Robertson trench header, latest addition to line of Q-Electrical Fittings. H. H. Robertson Co.

(125) CONTROLLER. Bulletin 4290 describes lifting magnet controller, automatic discharge type, for use with all types and makes of lifting magnets. The Euclid Electric & Mfg. Co.



New Cutler-Hammer oiltight pushbuttons give more circuit flexibility

Now you can make any pushbutton station you want from this new complete line of operators.

MORE THAN 30 DIFFERENT CIRCUIT ARRANGEMENTS

You can get these pushbuttons in one-hole or base mounting, six different colors. You can get more than thirty different circuit arrangements . . . hundreds of varieties of stations in standard arrangements of up to 25 elements. And you can get up to 8 circuits on one pushbutton. Flexible oil resistant diaphragm behind the button is designed to stay soft and pliable.

USE 40% LESS BEHIND-PANEL SPACE

This new Cutler-Hammer oiltight line gives you more control in less space because they use 40% less behind-the-panel space than the next smallest unit.

A colorful brochure, "MASTER DESIGN" will give you all the facts. Ask for Pub. LO-104-M241.

These new pushbuttons that give far greater circuit flexibility than any other make are the kind of improvements you can expect from Cutler-Hammer. Give your local sales office or distributor a call.

WHAT'S NEW? ASK...

CUTLER-HAMMER

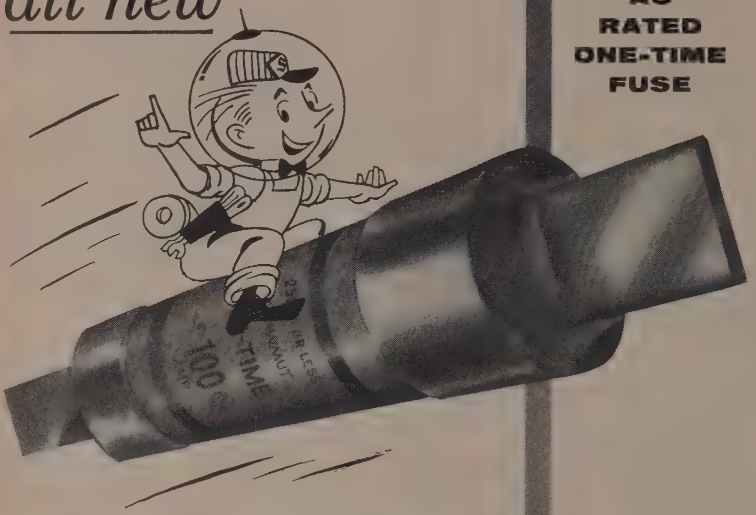
Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. • Associates: Cutler-Hammer Canada, Ltd.; Cutler-Hammer Mexicana, S. A.

CONTROL

SHAWMUT'S®

all new

THE ONLY AC RATED ONE-TIME FUSE



ONE-TIME FUSE

- The only AC rated One-Time fuse.
- Operates up to 38% cooler in switches and enclosures.
- Gives up to 700% more Time Delay than ordinary One-Times.
- Meets all Federal specifications.
- Exceeds all industry standards.
- Carries U.L. Label.
- Provides predictable performance.
- Available in a complete range of ratings — from 0 — 600 Amps.

ANOTHER SHAWMUT "FIRST"

This all-new, silver-plated, One-Time fuse is the biggest advance in One-Times since 1900. It has a "high efficiency link" and pays for itself in power savings alone. A current limiter, it gives the kind of positive protection that modern circuits demand. Until you use Shawmut's All-New, silver-plated One-Time, you'll never know how good a One-Time fuse can be. Send for Bulletin O-T 601 today.

THE CHASE-SHAWMUT CO.
374 MERRIMAC STREET • NEWBURYPORT, MASSACHUSETTS
SUBSIDIARY OF I-T-E CIRCUIT BREAKER CO.

(126) CONDUIT & DUCT made of "Marlex" high-density polyethylene are described in six-page folder. Triangle Conduit & Cable Co., Inc.

(127) FLOODLIGHT. Bulletin 2725 gives specifications and photometric data on new Quartz-beam floodlight. Crouse-Hinds Co.

(128) RANGE DRIVES. Brochure No. F-2028 describes application of the U. S. Varidyne all-ac-controlled speed systems to range drives for paper, fabric, plastic and metal strip. U. S. Electrical Motors Inc.

(129) SPEED MEASUREMENT SYSTEMS. Bulletin GEZ-3251, 12 pages, describes complete line of ac and dc tachometer generators and indicators. General Electric Co.

(130) RELAY TESTING. "The Coordination and Testing of Protective Relays in Industrial Plants" by T. L. Bourbonnais, II, is presented in Publication ET-2159. Multi-Amp Div.

(131) WIRE MARKING. Literature describes new self-laminating wire markers which offer resistance to all conventional oils, grease, chemicals, etc. Westline Products Div., Western Lithograph Co.

(132) LIMIT SWITCHES for use on machine tools, baling presses, washing machines, dough mixers, moulding machines and printing presses are described in Bulletin 9400. Atlee Corp., Monitor Controller Div.

(133) CONTROLLERS. Bulletins 78-05 and 7855 describe ac preset printing press controllers for applications requiring full torque start and slow down feature. Atlee Corp., Monitor Controller Div.

(134) TESTING EQUIPMENT. GEA-7178, 12 pages, describes and shows how to select line of 15 ac and 9 dc high-voltage dielectric test sets. General Electric Co.

(135) UNDERWATER LIGHTING Catalog Section G includes illustrations, specifications and dimensions on entire line of cast bronze low-voltage swimming pool lights for use in new or existing concrete, gunite, tile, steel or fiberglass pools. Stonco Electric Products Co.

(136) LUMINAIRE. Booklet SA-8869 describes new 750- and 1000-watt mercury-lamp streetlighting luminaire, Type OV-50. Westinghouse Electric Corp., Lighting Div.

(137) MOTORS. Bulletin 1430 describes D-Flange motors from 1 to 150 hp. Century Electric Co.

ESTIMATING FORUM—XII

[FROM PAGE 84]

mechanic's off-job personal activities and can cover the gamut from "domestic tranquility" to "domestic turmoil." While management has no control over the mechanic's "after-hours" activities, it has a definite interest for this can be a potent factor in the man's job productivity. More often than not, this factor is overlooked—perhaps because most mechanics lead a normal home-life and contractors are not looking for trouble from that source.

Suppose we use 100% as a mechanic's normal rate of productivity. The type of home-life he has may alter that rating all the way from 115% down to zero. The top rating (115% or better) is not uncommon for the man with a normal happy home atmosphere. He is mature, with family responsibilities, children to educate, and a nice home and job that he wants to improve. He takes his job seriously, gets to work on time, and works hard all day. His attitude and buoyant disposition give a lift to all who work with him.

The rather startling "zero" rating has been reached, fortunately, in very few cases. In between is the range of most concern. The degree of personal or domestic trouble or problems can usually be measured by a progressive drop in a man's job productivity. Cases of serious after-hours indiscretions are usually detected by apprentice training and contractor requirements and the offenders screened out.

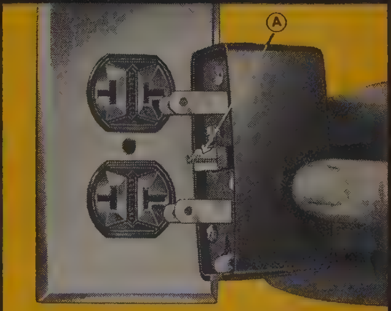
Productivity Studies

Studies of an electrician's aptitude and productivity are far more involved than similar studies of workmen in the ordinary industrial plant. The work picture of an electrician can change constantly. He works in different localities, on various types of projects, and with many crews. A study of his work on a specific day may not reveal the same results as a study of his work the next day or later.

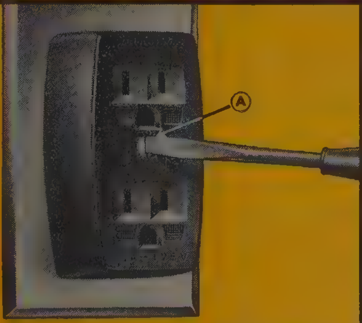
This discussion provides many ramifications, but they are all a part of the study of manpower productivity. The findings serve as a good background for the study of crew productivity which will follow in succeeding issues.

HUBBELL DUPLEX ADAPTER
15 A., 125 V.

Hubbell Duplex Adapter No. 5291 is easy to attach. Just remove screw holding metal or plastic plate to 2-wire receptacle. Leave plate in place.



Adapter plugs into 2-wire receptacle. Screw A will go through plate to grounded box. It is connected to both U-slots of adapter.



Tightening Screw A establishes adapter ground in a grounded system. If the system is ungrounded, connect adapter as shown at right.

When an existing system is not properly grounded, the adapter may be grounded by connecting a grounded wire to green hex Screw B.

FAST TEMPORARY CONVERSION TO 3-WIRE GROUNDING SAFETY

This polarized, plug-in adapter converts 2-wire duplex receptacles used with grounded or ungrounded systems to temporary 3-wire grounding receptacles. Landlords find it a great convenience when tenants requiring 3-wire facilities cannot postpone occupancy until rewiring is completed.

To make a conversion, nothing in the existing system has to be removed except receptacle cover-plate screws, to make room for a captive screw in each adapter. This captive screw acts as a conductor from the two U-slots to the grounded system. For use with receptacles in ungrounded systems, there is a green binding screw to permit connection of an independent ground wire. Either way, the electrically independent blades and contacts continue existing split circuits.

The polarized adapter operates in any parallel or T-slot duplex receptacle with metal or plastic cover plates. Brown or ivorine bakelite, for 15 amperes, 125 volts. Size: 1.4" from plate, 3.3" high, 1.75" wide.

KEEP PACE ELECTRICALLY

HARVEY HUBBELL INCORPORATED
Bridgeport 2, Connecticut
In Canada: Scarborough, Ontario

Symbol of Security

The small red box on the wall is the Gamewell "Century" non-code station – a symbol of the same dependable protection, *in* buildings, that the familiar Gamewell street box brings to most of our cities.

The attractive, functional *Century* box is just one element in the Gamewell "Flexalarm" line of interior systems. The Flexalarm *building-block* concept allows freedom in designing systems for maximum protection in every type of building. And this flexibility is backed by factory trained sales representatives who offer you the benefit of Gamewell's specialized experience in fire alarm engineering.

You can depend on the name of Gamewell. Fire protection has been our profession for over 100 years.

The Gamewell Flexalarm catalog illustrates typical fire alarm installations that afford maximum protection at minimum cost. For your copy, write THE GAMEWELL COMPANY, 1318 Chestnut Street, Newton Upper Falls 64, Mass. A Subsidiary of E. W. Bliss Co.

BLISS Gamewell®

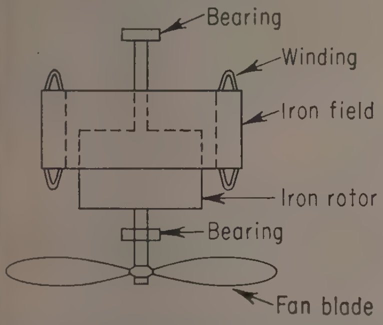
FIRST...WHEN SECONDS COUNT

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Cooling Motor Construction

QUESTION K39—We have a number of single-phase fractional-hp motors used to drive fan blades for cooling transformers. When we took them apart for maintenance, we noticed that the iron rotors did not line up with the iron in the stators.



About half of the rotor is out of the field. Could anyone tell us why these motors are constructed in this way?—H.G.R.

ANSWER TO K39—These fans are for vertical operation and do not, as a rule, run continuously. They do not get checked too frequently and must be ready to operate whenever the transformer temperature rises to the setting of a thermostat. To keep the size down to avoid bulkiness and still get a good motor in a small package, the magnetic bearing principle is made use of. Part of the rotor iron being out of the stator while at rest eliminates the need of a thrust bearing. Hence while running, the rotor is pulled up into the stator, relieving the thrust load due to the weight of the fan blade. You will notice you can move the rotor up and down (or in and out) quite a bit, so be careful of shim replacement when reassembling.—W.E.G.

ANSWER TO K39 — The motor shown is usually described as a free-floating non-friction fan motor. They are usually of a sleeve bearing type and have metal end-thrust washers where the ball bearings are normally located. The long shaft of the motor acts as a unit bearing. When the fan is in operation the magnetic pull between the rotor and iron stator fields pulls the two nearly in line, thereby eliminating all end thrust on the motor unit.

When the motor is shut down, the weight of the rotor causes it to fall; thus the need for the end thrust washers. Felt washers are also required to reduce motor noise during the periods of acceleration and deceleration.—H.E.H.

ANSWER TO K39—The rotor is not placed in line with the stator because the design is such that the magnetic coupling of the rotor to the stator is to be weak.

The coupling is to be weak so that if the motor is stalled, due to wind blowing against the fan blades, the motor will not overheat or burn-up. It follows that a motor with high magnetic leakage is able to withstand stalling since the stator winding is designed to dissipate the excess heat generated by poor coupling.—T.W.C.

Heat Effect on Iron

QUESTION L39—In removing stator windings from motors, we have used a baking oven at 500 degrees for a period of eight hours. This burns out all the insulation, varnish and paint off the motor. Would this amount of heat change the characteristics of the iron lamination? They tend to be a little soft on the outer punchings.—E.S.H.

ANSWER TO L39—Electrically or magnetically the iron laminations will not change at a temperature of 500° F. These characteristics will not be affected up to a temperature of 750° F; however, depending upon the age of the motor, the following can happen. Some insulating materials used to insulate one lamination from another lamination will run and leave the space between two laminations uninsulated, if exposed to 500° F for as long as 8 hours. If this happens, then the effect of lamination is somewhat decreased and as a result the eddy-current losses will increase, giving a final result of a decrease in motor efficiency.—T.W.C.

ANSWER TO L39—Magnetic fatigue or aging characteristics is a function of temperature. This means that iron subjected to elevated temperatures over long periods of time, as in transformer cores and motor rotors and stators in continuous operation, develops magnetic fatigue which causes increased core loss. Prolonged heating at even so low a temperature as 50° C, if continuous for several weeks, will produce an appreciable effect.

However, electrical steel has substantially non-aging characteristics within normal operating temperatures. The 500° temperature you speak of will adversely affect the characteristics of the iron. There will be an increase in hysteresis loss, but this will be slight.—J.M.

Porcelain Insulator Tests

QUESTION M39 — We have recently had a failure on our 4160-volt distribution board. The fault occurred across one of our porcelain insulators to ground. The insulator showed signs of burnt spots where the current flowed to ground, but we were able to remove this discoloration. The questions are: 1) How can these insulators be tested? 2) Was the insulating properties of these insulators damaged or destroyed? and 3) How can similar failures be prevented?—J.A.M.

ANSWER TO M39—1. The insulator can be tested by high-potential test. If the necessary equipment is not at hand, it can be rented; or in most areas the services of a test engineer can be obtained, who for a reasonable fee will conduct the testing.

2. The insulators have not been damaged unless they have cracked or are permanently marked.

3. The discoloring mentioned in the question was a result of a combination of the arc, dirt, oil or moisture. To prevent further occurrences keep the insulators clean and dry.—T.W.C.

ANSWERS TO M39 — There are two publications you may find helpful:

Standard 41 of the American Institute of Electrical Engineers

JOB-PROFIT TOOLING IDEAS

FROM GREENLEE

"We saved several thousand dollars with GREENLEE TOOLS on a complicated missile site contract,"

says FRED S. BREECE

superintendent of electrical construction
for A. NERI, Inc., of California

A. Neri, Inc., of California, is the electrical contractor for three Titan missile-launching complexes near Mountain Home, Idaho. Specifications for this job call for approximately 345,000 feet of rigid conduit and over 90,000 feet of thin-wall conduit. Installation requires more than 14,000 bends and 2,000 knockout openings for distribution and junction boxes.

Ralph Neri, assistant superintendent on the job, reports; "We are using Greenlee benders, knockout punches, and punch drivers exclusively. In most cases we have been able to take the tools right to the conduit instead of taking the conduit to the tools . . . and get the job done faster."

This view (right) of one of the missile-launching sites gives some idea of the complexity of this job. The cylindrical structure still in the forms is the entrance portal for the entire complex. The concrete dome will house the control center. When the work is completed, all these structures will be completely underground.

Work area in the tunnels and other structures in the missile-launching complex is so limited that A. Neri, Inc., set up a prefabricating shop where bends in various diameter conduit are made on Greenlee benders. The finished bends are then taken to the construction site for installation, substantially reducing the man-hours required to complete the job. Two No. 884-E one-shot benders with 4″ capacity, and powered by Greenlee No. 798AC-SA two-speed hydraulic power pumps, are used in this prefab shop.

Bending conduit right on the job is done on three Greenlee No. 880-M2 benders like the one shown above. Breece reports the light weight and compactness of these tools are a definite advantage to job efficiency in the confined work areas of the tunnels. All benders are operated either by Greenlee hydraulic hand or power pumps. According to Breece, there have been no major repair or maintenance costs with any of their Greenlee tools — another big saving for A. Neri, Inc.

To complete this job, workmen for A. Neri, Inc., will make over 4,000 bends in 90,000 feet of ½″ through 2″ thin-wall conduit, using three Greenlee No. 880-M2T thin-wall benders (as pictured above).

For total bending work on both thin-wall and rigid conduit on this contract, Breece estimates his company will save several thousand dollars through the use of Greenlee benders.

"We also should save by using Greenlee knockout punches and drivers," Breece states. To speed the work of making over 2,000 knockout openings for ½″ through 4″ diameter conduit, A. Neri, Inc., is using Greenlee No. 7310 hydraulic knockout driver and punch sets (as shown above), Greenlee No. 1731 one-shot knockout punch driver, and the No. 1804 ratchet knockout driver.

Greenlee equipment used for this contract was purchased from National Electric Supply Company, Oakland, California, whose representative worked closely with A. Neri, Inc., in providing the right tools for each job. For help in selecting the exact GREENLEE JOB-PROFIT TOOLING needed to streamline *your* operations, help control costs, and assure a better return on your tool investment, see your Greenlee distributor . . . or write for Bulletin E-240A today.

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(ASA C29.1), covering the manner of making insulator tests.

High-Voltage Insulator Standards of the National Electrical Manufacturers Association, describing the test, tolerances, and causes for rejection of faulty insulators.

Proper tests of insulators demand lab-controlled conditions. All results, to be meaningful, must be corrected to standard barometric pressure, temperature and humidity. This is most definitely not a one-time, do-it-yourself project.

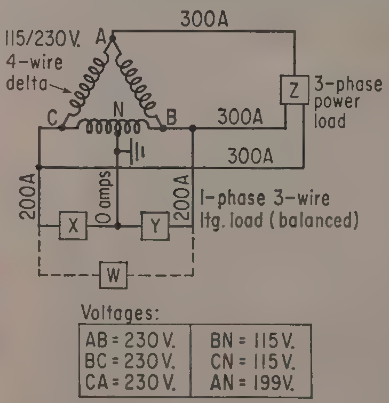
The insulating qualities of your insulators may very well be damaged. I believe the best course for you to take is to have the manufacturer's application engineer look over your installation, have the necessary test made, and then follow his recommendations.—F.W.G.

4-Wire Delta Loads

QUESTION N39—In a 4-wire delta system where a high phase is present, how would I compute the service neutral where it has power and light load combinations? Power load equals 300 *amps; light load equals* 200 *amps.*—V.S.

ANSWER TO N39—Since the neutral conductor is not used for the 3-phase power load, there is no neutral current flowing from load Z to N.

Assuming that load X is exactly the same as load Y, there is no neutral current flowing when both loads are connected. When load X is completely shut off, the current flowing through load Y will also flow through the neutral conductor. When load Y is completely shut off, the current flowing through load X will also flow through the neutral conductor. Any load connected without a neutral connection (load W) does not draw neutral current. Hence, the maximum neutral current flowing would be determined by load X or load Y, whichever is the larger. This is the method used to calculate the neutral feeder load in accordance with Section 220-4(d) of the 1959 NEC. The service neutral size as required in Section 230-41 NEC is dependent upon Section 220-4(d).—H.S.H.

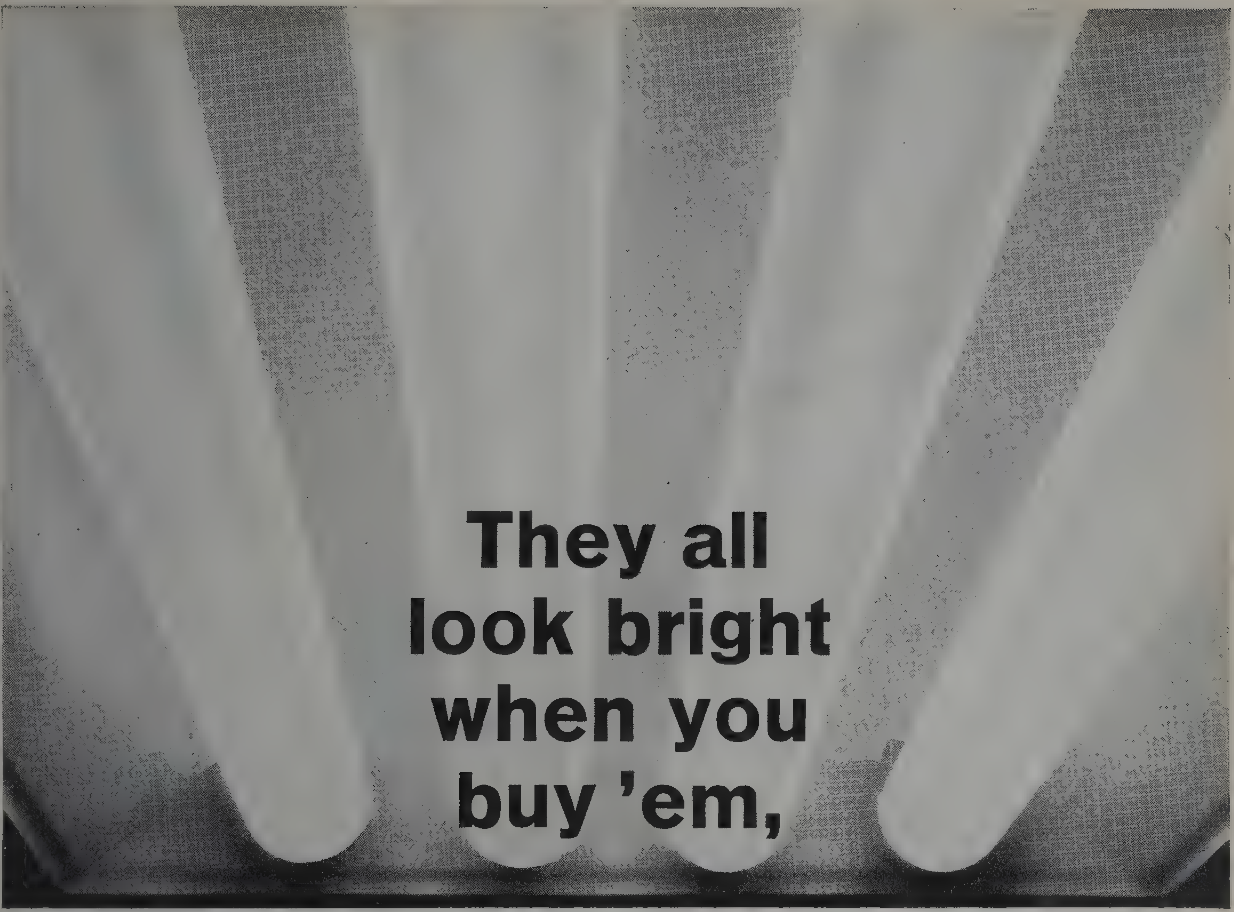


AB = 230V.	BN = 115V.
BC = 230V.	CN = 115V.
CA = 230V.	AN = 199V.

ANSWER TO N39—Since all pertinent facts have not been stated, a few assumptions will have to be made, based on what will be found on a common installation of this type.

Because you mention power and lighting loads, one can assume that the 300 amps represent the 3-wire 3-phase load and the lighting load is 200 amps. This combination would also indicate that the 4-wire delta system is 115/230 volts with 3-phase line voltages of 230 volts, and one center-tapped single-phase transformer connected across two phases, producing 115/230 volts for the 200-amp lighting load. Normally the center-tapped single-phase transformer will be sized large enough to supply its portion of the 3-phase 3-wire load plus (vectorially) the 115/230-volt single-phase load. The high-voltage leg you speak of is that phase not connected to the center-tapped single-phase transformer and will be 1.73 times the line-to-neutral voltage of the two other phases, which in this problem would be 1.73 times 115 volts or approximately 200 volts. Naturally no lighting load would be connected from the high leg to the neutral, so this leg is present only to complete the 3-phase source for the 3-wire 3-phase loads.

If we can assume that the 200-amp lighting load is supplied from the 115/230-volt single-phase transformer, and the loads connected to the neutral are balanced, then the neutral would carry no current. However, Paragraph 220-4(d) of the NEC requires that line-to-neutral loads of 3-wire single-phase systems up to 200 amps be sized to full capacity. On the problem at hand this would mean that a minimum of three No. 3/0 RH conductors would be required to feed the single-phase distribution center from the point of tap to the 4-wire delta supply. The neutral could be smaller only if some of the single-phase loads supply 2-wire 230-volt appliances from this portion of the supply. For example, assume that the 115/230-volt load of 200 amps supplies a balanced 3-wire single-phase load of 100 amps and a 100-amp load for 230-volt 2-wire appliances. Then the neutral need be



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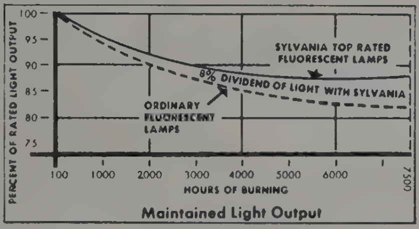

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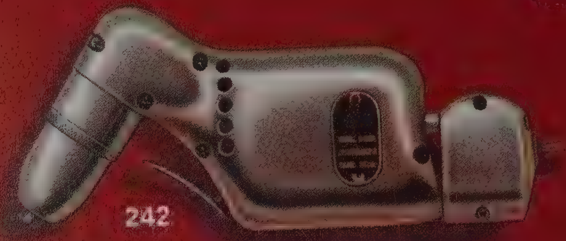
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sized only for 100 amps, the maximum unbalanced load from line to neutral. Therefore, the single-phase 3-wire feeder could be two No. 3/0 RH and one No. 2 RH. To summarize the foregoing, computing the size of a neutral for a 4-wire delta system is the same as computing the neutral of a common 3-wire single-phase supply.—J.H.W.

Can You Answer These QUESTIONS?

QUESTION X39—The consensus of opinion at our plant is that economics dictate in the design of "T" connected transformers for 3-phase to 3-phase power in capacities of 15 kva and less.

I would appreciate a discussion on the subject of economics of design for 3-phase transformation on "T" connected vs. 3-phase transformers.—J.A.M.

QUESTION Y39—We have a 100-amp, 3-phase, 208/120-volt lighting panel with a 50-amp, 3-pole, "EH" frame, main breaker and nine 20-amp, 1-pole, "EQ-B" frame branch circuit breakers. All branch circuit wire is No. 12 TW. The current available with a short circuit at the panel is 14,000 amps asymmetrical; a fault on a branch circuit 5 ft or more from the panel would have 5,000 amps or less available. Should "EH" frame breakers have been used for the branch circuits to protect against a fault in the first 5 ft, or will the main breaker handle this?—A.G.C.

QUESTION Z39—I have, in several cases, tried to pick up wattless current with 1.0 pf synchronous motors by increasing the dc excitation. It just doesn't work. Why?

I have done this with 80% pf machines (motors and generators) and it does work.

Why, if we have an 80% full load on a 1.0 pf motor, will it not carry the balance of its capacity in kvar the same as one rated at 80% pf will do when carrying 100% of its rated hp or kw load?

I have tried this on 1.0 pf motors working at only 20% to 30% of their rating; even then I was unable to get an increase in motor amps with an increase in field excitation.—A.A.N.

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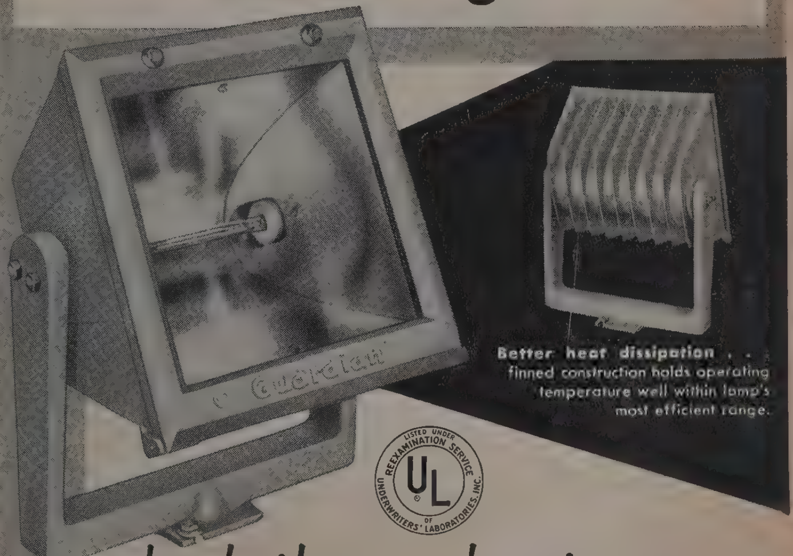

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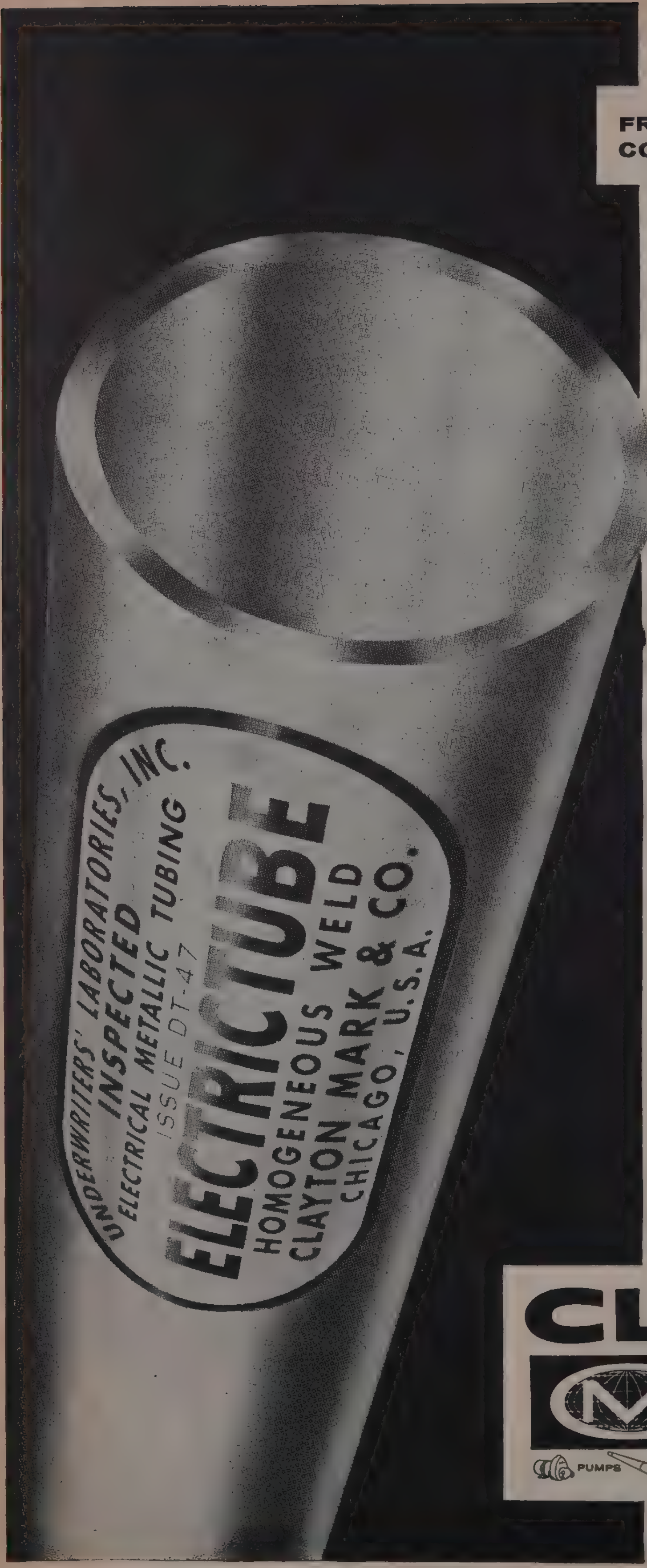

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4545

Questions on the Code

Answered by:

B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

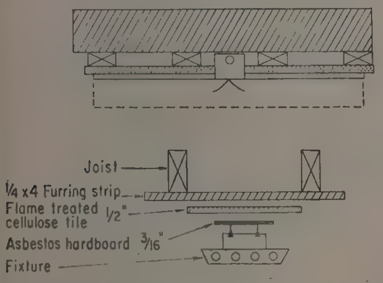
Fluorescent Fixtures Cellulose Tile

Q. *Below is a sketch showing a typical cellulose tile ceiling installation and a proposed installation of fluorescent fixtures on it. You will note that we intend to have the fixture separated from the tile (which is flame treated) by a strip of asbestos hardboard 3/16 in. thick extending the entire length of the fixture and over each side ½ in. and having no openings except where mounting screws and wires go through.*

We believe this installation is more fireproof than if the same fixture was mounted on some wood panels which is permitted.

Is this type of installation a violation of the intent of the code? If so, please explain.

Our local city inspector (who is new on the job) thinks so, however, the old one who had been inspecting for over ten years had been accepting it. Many buildings and homes now have ceilings of less than 8 ft and recessed fixtures of same light output are much more expensive. Even the 1½-in. extra head room is sometimes desirable. —T.W.M.



A. For the convenience of our readers, the provisions of Section 410-74(b) which apply are quoted as follows:

"(b) Combustible Low-Density Cellulose Fiberboard. Where a fixture containing a ballast is to be installed on combustible low-density cellulose fiberboard it shall, where surface mounted:

"(1) Be approved for this condition, or

"(2) Be spaced not less than 1½ in. from the surface of the fiberboard.

Consulting Editor B. A. McDonald, for the past 11 years a major contributor to this department, died on May 10 after a brief illness. See page 177. His wide knowledge, long experience and prolific articles in the field of code application, interpretation and compliance won for him a devoted, nation-wide following. Some of his most recent commentaries, as yet unpublished, will continue to appear in this department. Comments or questions regarding them should be directed to "Questions on the Code."

"(3) Where such fixtures are partially or wholly recessed, the provisions of Section 410-62 to 410-70 shall apply.

"Combustible low-density cellulose fiberboard is considered to include sheets, panels and tiles which have a density of 20 lb per cu ft or less, and which are formed of bonded plant fiber material; but does not include solid or laminated wood, nor fiberboard which has a density in excess of 20 lb per cu ft."

This code rule, under Section 4184, first appeared in the 1956 edition of the code. The occasion for the rule was prompted by field experience which indicated numerous fires due to the mounting of fluorescent fixtures on combustible surfaces. When Code-Making Panel No. 10 deliberated the matter back in 1955, one of the remedies considered was "the insertion of noncombustible material between the fixture and ceiling." Other factors, such as the treatment of ceilings to make them less combustible, also were considered. This is a matter of record in the 1955 report of the "proposed amendments to the 1953 Code." In so far as the "treatment of fiberboards to make them less combustible" is concerned, Panel No. 10 expressed the opinion that the effectiveness of such procedure is questionable.

In view of the foregoing it appears evident that the members of C. M. Panel No. 10 did not consider the insertion of non-combustible material, such as asbestos board, between the fixture and the ceiling, or the flame treatment which you propose, as sufficient safeguards against the fire hazard involved. As a result, it is my opinion that both the intent and the literal text of Section 410-74(b) may only be satisfied when one of the two specific requirements are satisfied. Underwriters' Laboratories now list fixtures which may be installed on low-density cellulose fiberboard.

Regardless of the foregoing personal opinion, some inspection authorities have, and are now recognizing the use of asbestos cement boards, ⅛ or 3/16 in. thick between the fixture and the ceiling. Others are recognizing fiberboard with a density in excess of 20 lb per cu ft for the same purpose. Such procedure is based on the premise that the fixture is not directly installed on a combustible low-density cellulose fiberboard ceiling. As a result, there is a conflict of opinion which will continue to prevail until an Official Interpretation, or a code revision clarifies the question.—B.A.McD.—6/61/1

Location of Warning Signal

Q. *Our company is drawing plans and writing specifications for a hospital addition. In the addition, there will be an operating room. Our question concerns the location of the ground-contact indicator. The doctor in charge of this hospital does not want the audible warning signal located in the operating room. Would appreciate your comments on this problem. —D.H.*

A. Your statement is covered in Article 517, Flammable Anesthetics, of the NEC and your attention is called to 517-6 (d), Circuits in Anesthetizing Locations, which reads:

"In addition to the usual control and protective devices, the ungrounded system shall be provided with an approved ground-contact

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	No. 5100	No. 5300
½" Conduit or Pipe	2 3/16"	EMT 4"
¾" Conduit or Pipe	4⅛"	EMT 5"
1" Conduit or Pipe	5¼"	EMT 6"
	No. 5200	**No. 5400**
1¼" Conduit or Pipe	6⅞"	EMT 8"
1½" Conduit or Pipe	8¼"	EMT 10"

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indicator so arranged that a green signal lamp conspicuously visible to persons in the anesthetizing location remains lighted while the system is isolated from ground. An adjacent red signal lamp and an audible warning signal shall be energized when any conductor of the system becomes grounded through a resistance or a capacitive reactance of any value up to at least 60,000 ohms. The current through the ground indicator to the ground shall not exceed 2 milliamperes. The indicator and associated signals shall not be installed within a hazardous area.

"The proper functioning of the indicator should be tested at intervals of not more than one week by grounding successively each conductor of the energized distribution system through a suitable meter or resistor. Such tests should be made only while the location is not being used and when entirely free from combustible gases or vapors. A permanent record should be kept of the results of such tests."

I also call to your attention the National Fire Protection Association No. 56, which is the code for use of flammable anesthetics, and I call to your attention the following that is in addition to (d) as quoted above. Under A 244 of the NFPA Pamphlet No. 56, the following statement is recorded:

"It is recommended that a separate isolating transformer and ground indicator be used for each room of anesthetizing locations, so that ground alarms in one room do not disturb persons in other rooms. In any event, the rated capacity and the number of circuits connected to each transformer must be small enough that normal capacitance and leakage currents from the system to ground do not prevent proper operation of the ground indicator."

From the above-mentioned publications, it is the writer's opinion that the audible warning signal is required in the anesthetizing location to be out of the hazardous area, which would mean above the 5-ft floor level area.—R.E.W.—6/61/2

Insulation Thickness Over 600 Volts

Q. *For underground primary 4800/8320Y distribution feeders to semi-buried transformers serving a multi-building school, our specifications are as follows:*

"Cable shall be single conductor

No. 2 AWG 19-strand copper, with 10/64-in. minimum insulation thickness of butyl-base compound, a 3-mil by $\frac{3}{4}$-in. copper-shield tape and a $\frac{5}{64}$-in. Neoprene jacket. Cable shall have physical and electrical characteristics in strict conformity with ASTM and IPCEA requirements for 5000-volt shielded cáble and shall have had a certified manufacturer's test of 14 kv. The electrical contractor shall test for continuity of shield tape between all terminal points of each length of cable installed, and provide a standard AIEE Installation Hi-Potential test after installation and prior to placing cable in service.

"Three (3) No. 2 1/c insulated cables and one (1) No. 2 1/c bare neutral shall be run in 4-in. fiber duct with concrete encasement as shown on plans."

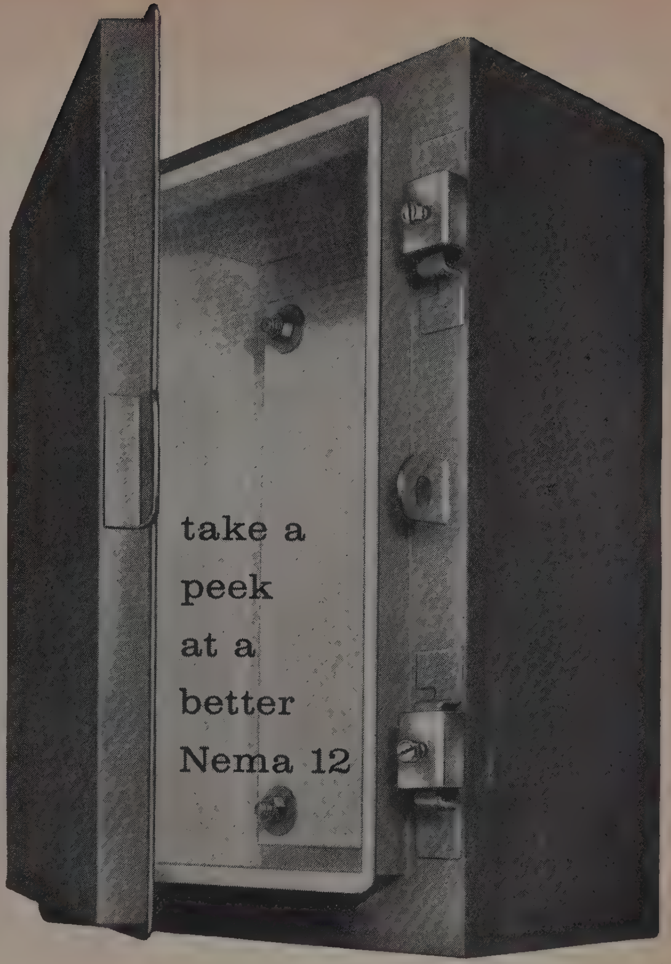
At the present time, the system primary supply voltage is 4800 volts delta but will ultimately be changed to 8320Y, or 8320 volts between phases or 4800 volts phase to ground. It is, therefore, the power company's contention that the cable insulation thickness should be $\frac{12}{64}$ in. instead of the 10/64 in. specified.

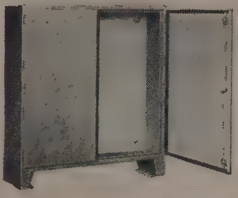
It is our contention that inasmuch as the 10/64 in. butyl-base insulation lies between the conductor and the grounded shield tape, the voltage, therefore, shall never exceed 4800 volts and the insulation is therefore adequate.

I shall certainly appreciate your comment and opinions on this matter.—L.D.B.

A. According to the provisions of Section 310-2(h) of the National Electrical Code (Table 310-2(h-1), the minimum thickness of a rubber insulated No. 2 conductor operating at 5000 volts is required to be 10/64 of an inch. The fine print note following Section 310-2(d-5) advises that "the working voltages referred to in the Table are the operating voltages between phases of single and 2-phase systems, and 3-phase systems with grounded or ungrounded neutral." In view of the foregoing, the No. 2 single conductor cables operating on a 4800-volt delta system, and insulated with 10/64 in. of rubber fully satisfy the requirements of the NEC, and the Underwriters Laboratories' list of conductors coming within the scope of this voltage (5000 volts).

When the voltage of the present system is changed to 8300 volts between phase conductors and 4800 volts to ground, it appears ob-

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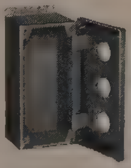
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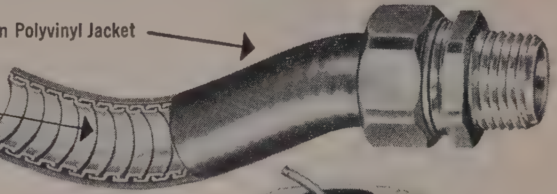
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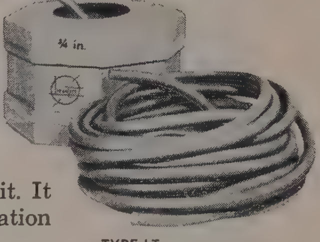

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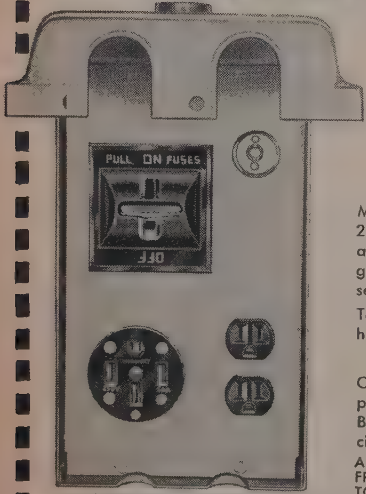

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vious that the 10/64-in. insulation is not sufficient to satisfy the degree of safeguard established by the NEC. While the voltage from phase to the grounded shielding is limited to 4800 volts, the voltage between the phase conductors is 8300 volts, and, as stated above, this is the working voltage on which the insulation thicknesses are established. While the code does not specifically cover conductor voltages in excess of 5000, it is significant to note the provisions of paragraph (a) of Section 310-1: "The purpose of this Article is to assure that conductors have mechanical strength, insulation, and current-carrying capacity adequate for the particular conditions under which they are to be used." In the absence of specific rules, this fundamental requirement places the responsibility for an interpretation on the authority enforcing the code rules. Under such circumstances, the inspector may consult the manufacturer for advice, and it appears from catalogue information that he would require the use of 13/64-in. insulation. This opinion has been verified by contact with a cable manufacturer. I also believe that the recommendation of an electrical utility should not be discounted. They have, through many years of field experience, come to know the importance of insulation. A fault on a primary serving a multi-building school is a serious matter. The entire property or sections of same would be deprived of power depending upon the location of the fault. Such a fault at night could be the occasion for personal injuries unless emergency lighting is provided in all sections of the buildings involved. All of the essential electrical services to the school would be interrupted, and I don't believe one should speculate with the thickness of insulation when so much is at stake.—B.A.-McD.—6/61/3

Non-Interchangeable Circuit Breakers

Q. *The provisions of Section 240-25 of the 1959 Code require that circuit breakers, within the range specified, "shall be so arranged that it will be difficult, after a circuit breaker is installed, to replace it with a breaker of a higher ampere classification." The rule also advises that "circuit breakers of higher than the 0-20 amp classification shall be difficult to install in the spare spaces which are left* *for future additions." Just how is the phrase "difficult to replace or install" satisfied and how are such breakers identified? Will such breakers be of the time-delay type? Paragraph (b) of this Section only recommends that CBs of the 0-30 amp class be of the time-delay.—A.B.*

A. The provisions of Section 240-25 (g) are quoted as follows:

"Non-interchangeable Circuit Breakers. Circuit breakers used for lighting and appliance branch circuits in residential and other occupancies except where the conditions of maintenance and supervision assure that overcurrent protective devices and branch-circuit wiring will be maintained at proper rating, shall be non-interchangeable in accordance with the following provisions:

"(1) Circuit breakers rated within the range of 0-250 volts, alternating current and not more than 100 amps shall be classified as regards current as follows:

Amperes
0-20
21-50
51-100

"(2) Such circuit breakers or their multiple mounting and bussing means shall be so arranged that it will be difficult, after a circuit breaker has been installed, to replace it with a breaker of a higher ampere classification.

"(3) Such circuit breakers of higher than 0-20 amp classification shall be difficult to install in the spare spaces which are left for future additions.

Note: The provisions of Paragraph 240-25(g) shall become effective on July 1, 1960."

This new code rule intends to satisfy the hazard which results when circuit breakers may be readily interchanged from a low rating to a higher rating without any consideration for overloading the panelboard or the feeder serving same. Previous to this rule anyone could replace a 20-amp CB with a 50-amp breaker merely by inserting one in place of the other. This new rule was sponsored by the International Association of Electrical Inspectors, who from field experience found that this indiscriminate use of circuit breakers promoted a fire hazard.

While the phrase "difficult to replace or install" appears to be ambiguous, it becomes quite clear when the authority enforcing the code accepts Underwriters' Labora-

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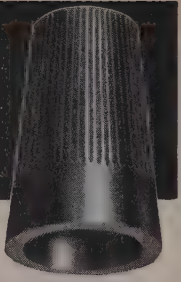

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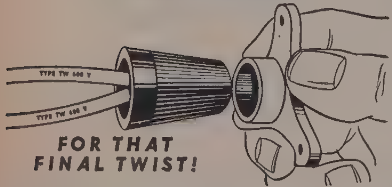

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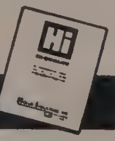

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tories concept of the degree of safety intended by the code. Reference to page 46 of the 1960 Construction Materials List of UL indicates that a standard has been established as a basis for the approval of such circuit breakers. They are identified as NI (non-interchangeable breakers). They are rated 100 amps or less, 250 volts ac or less, in conjunction with the mounting or bussing means in Class NI devices, such as panelboards, panelbase assemblies, service equipment, circuit-breaker enclosures, etc. The combination of NI breakers and their NI devices are intended to provide the non-interchangeability concept prescribed by the NEC.

Quoting from UL: "Class NI circuit breakers are classified as regards current rating as follows: 0-20, 21-50, 50-100 amps. Where a label serves as the identifying means the background color of labels is green for 0-20, yellow for 21-50, and red for 51-100-amp classifications. Where the label marking is printed directly on the body of the circuit breaker, the color of the printing is to be the same as the background colors described above."

All Class NI circuit breakers rated 30 amps or less are of the time-delay type.

Class NI circuit breakers may be identified by the phrase "NI Circuit Breakers" as part of the inspection manifest.

See Panelbase Assemblies, Panelboards, Service Equipment, Circuit Breaker Enclosures, etc. covering the receiving means for Class NI circuit breakers.

Reference to the UL listing of Panelboards on page 242 indicates that the inspector must determine that both the circuit breakers and the receiving devices are labeled as Class NI. UL also advises that panelboards may be classified as NI only if they have provision for two or more Class NI circuit breakers for lighting and appliance branch-circuit overcurrent protection. Similar advice is given under the listing of Service Equipment. One should become familiar with the UL advice which forms the basis of approval of Class NI breakers and holding devices.

At a recent meeting which I attended, representatives of eight different manufacturers briefly outlined the method by which their product satisfied the provisions of Section 240-25(g-2). While a few of the designs were similar, it was interesting to note that all were

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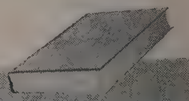

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ELECTRONIC MAINTENANCE attracted SRO attendance at EMEA meeting in Los Angeles when subject was analysed by Wally Wingert, assistant supervisor for Electronic Training for North American Aviation; C. Leon Perry, supervisor, Engineering and Utilities, Columbia-Geneva Steel Div., United States Steel Corp.; Gerald W. Anderson, electrical engineer, U. S. Rubber Co.; George A. Poate, electrician with Hearst Los Angeles Newspapers, and Merle A. Plumber, service requirements engineer with the L. A. Department of Water and Power.

arranged so that the replacement of a small breaker by a larger one could not be made without the services of an electrical contractor who is familiar with the equipment, understands the code objectives, and realizes the responsibility he assumes when making such a change. His responsibility is to see that such a change will not overload the panelboard or the wiring and equipment serving same. In other words, it appears that the UL concept of this code rule recognizes interchangeability of breakers only when such procedure comes within the scope of a qualified contractor or electrician who understands the hazards which may result due to inadequate wiring, and corrects the situation accordingly. Many of the designs required the use of a special tool available only to contractors. The ingenuity of the various designs reflected a desire to provide some quality or mark which would distinguish one product from another. Regardless of the variation in design, the standard of UL is satisfied, and it appears to me that a "do-it-yourself" mechanic would find it difficult to interchange circuit breakers without having a thorough knowledge of the circuit-breaker instruction for each manufacturer.

As previously noted, Class NI circuit breakers rated 30 amps or less, listed by UL, will be of the time-delay type. Section 240-4 covers this factor up to 20 amps.—B.A.McD.—6/61/4

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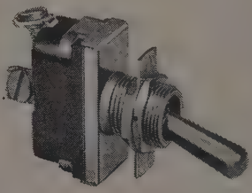

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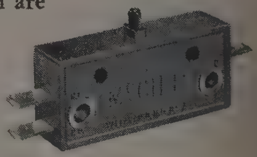

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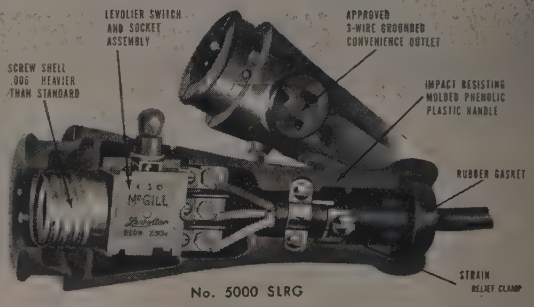
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NFPA Electrical Section Meeting

On May 16, the NFPA Electrical Section held its annual meeting in Detroit at the Statler Hilton hotel.

The major purpose of the meeting this year was to hear informal reports by 17 NE Code-Making Panels and five special technical subcommittees.

H. B. Whitaker, vice president of Underwriters' Laboratories, presided over the meeting. This was his first NFPA meeting as chairman of the Correlating Committee for the Electrical Section of the NFPA.

Chairman Whitaker's opening remarks stressed that all reports given at this meeting were on an informal basis. He pointed out that complete formal reports will be included in an NFPA Preprint pamphlet due to be issued July 1, 1961. After publication of the Preprint, industry groups will have until December 1, 1961 to study all new code proposals and register comments with appropriate code-making panels.

After this, code panels will review all comments and will make their final recommendation to the Correlating Committee by February 15, 1962. Following approval of the Correlating Committee by March 15, 1962, all proposed changes will be forwarded to the NFPA for printing and distribution. The next step will be to present all code changes to the May 15, 1962 NFPA meeting for final approval. Upon approval by the NFPA and formal adoption of the revised code by the ASA, the 1962 edition of the NEC is scheduled to be published by September, 1962.

Whitaker announced the recent appointment of Lou LaFehr, electrical inspector, Alhambra, Calif., to the Correlating Committee.

Retiring Correlating Committee member Ellis Cannady presented a gavel set with engraved names of past and present living members of the Correlating Committee to M. M. Brandon, president of Underwriters' Laboratories, who had served as chairman of this committee from 1951 through 1961. Cannady emphasized the outstanding service to the electrical industry rendered by Brandon during his tenure of office as CC chairman.

Frank Stetka, electrical field engineer for NFPA and secretary of the correlating committee, reported on his activities during the past year. His work included attendance at numerous IAEI chapter and section meetings for the purpose of explaining the intent of NEC rules.

B. H. Martin gave a report on "Underwater Swimming Pool Lights," the subject of one of the five special technical subcommittee reports presented at the meeting.

Martin explained that his committee had been gathering data from the field since last fall regarding fatalities and accidents in swimming pools resulting from faulty pool lighting. Only five case histories were brought to the committee's attention from the field in spite of appeals, at numerous electrical meetings and in several trade publications, for case histories concerning this important subject.

The pool lighting committee votes were based on four propositions: 1) Prohibit all forms of underwater pool lighting; 2) Use only dry-niche type pool lights; 3) Use 120-volt circuits to pool lights with a separate copper grounding conductor to effectively ground all metal parts of niches, fixture frames and deck boxes; and 4) Provide low-voltage pool lighting at 30 volts or less.

Committee action, by a vote of 3 to 2, recommended the adoption of proposition No. 3, which stresses beefing up grounding requirements for 120-volt fixtures.

A minority report was rendered by William Lowell of Sylvania Electric Products Inc., one of the five subcommittee members. Lowell stated that grounding was not the ultimate solution and that low-voltage pool lighting would offer a safer installation. He further added that it was not possible for a manufacturer to design a wet-niche fixture that would not result in small current leakage in time. Such small current leakage will not operate a branch-circuit overcurrent device, but the current would be sufficient to cause fatal shock or severe injury. Lowell also stated that proper maintenance of pool lighting is unlikely in view of past performances.

Other committee reports were: "Machine Tool Electrical Standards," presented by E. E. Carlton; "Circuits for Heaters and Other Appliances Operating at Voltages Above 150 Volts to Ground," presented by H. H. Watson; and "NEC Interpretation Procedures," presented by Frank Stetka.

Chairmen or members of 17 code-making panels gave informal reports on the highlights of code proposals recommended for the 1962 NEC. A number of important proposals, remaining on the docket for further study, were also discussed.

Highlights of the CMP recommendations are as follows:

1. That all 15- and 20-amp receptacles be of the 3-pole grounding type with the possibility of an effective date of 1964, which would allow manufacturers and suppliers sufficient time for transition of production and disposal of existing stock. H. H. Watson, chairman of CMP No. 2, stressed that this new proposal did not in any way imply that

SECTIONAL WINNERS of the Chicago Section, IES Lighting Competition (commercial and industrial classification) being congratulated by chairman Don Ingwersen (left) are: (L to R) E. M. Borre, Cooley & Borre, architects, Park Ridge, Ill., (3rd place for church lighting); F. R. Valvoda, Frank Valvoda Associates, Chicago (2nd place for church lighting); L. D. Chicca and Melvin Cohen, A. Epstein & Sons, Inc., Chicago (1st place for lobby and gallery lighting).

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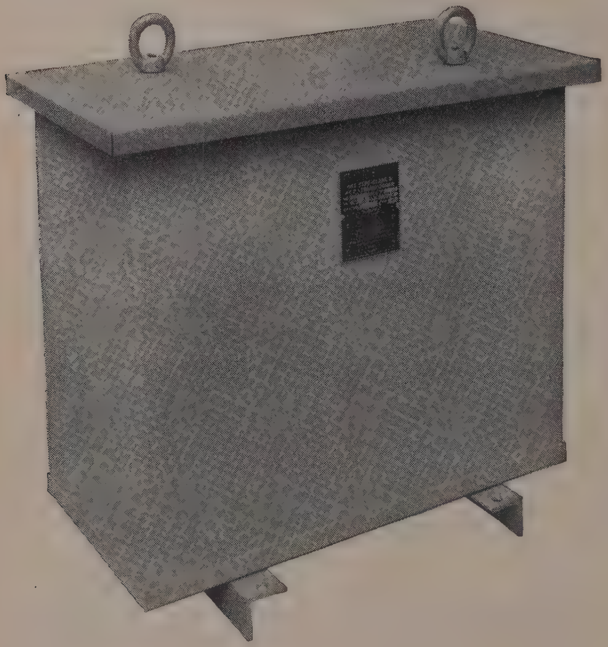

DONGAN DRY-TYPE TRANSFORMERS are made in both class B 80° Cent. Rise and Class H 150° Cent. Rise. Single phase transformers, 25 V.A. to 100 KVA; three phase, 3 KVA to 300 KVA. Suitable for indoor or outdoor applications. Designed for wall or platform mounting. All have roomy wiring compartments.

Sizes 5KVA and larger feature tap-changing and voltage-changing terminal board equipped with solderless connectors for speed hook-up. Built to meet or exceed NEMA specifications.

Dongan also makes transformers for-signaling-machine tools-control-back and boost-high voltage secondary for oil and gas burners-neon signs.

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Telephone: LO-2-3974

THE IMPACT OF good estimating on a successful contracting operation is aired by: (L to R) W. J. Oppelt, Oppelt Electric & Supply Co., Muscatine, Iowa; H. L. Moldt, Jr., Moldt Electric Service, Dubuque, Iowa; and H. G. Koehler, Koehler Electric Co., Madison, Wis. Trio attended two-day electrical contractor seminar at University of Wisconsin.

all portable appliances on 120- and 240-volt circuits were to be grounded. But the proposal does make it possible to readily ground portable equipment if desired.

2. In Section 210-6(a), Exception 2, the 8-ft minimum clearance from the floor for electric-discharge lighting units operating on branch circuits from 151 to 300 volts to ground has been deleted.

3. Wireway has been included as an acceptable wiring method in Section 230-44 for service-entrance conductors.

4. A new table will appear in Article 220 for demand factors of water heaters, similar to Table 220-6 in the 1959 NEC for clothes dryers.

5. A new section will be added in Article 240 to permit supplemental overcurrent protection of equipment. In such cases, supplemental overcurrent protection (15 amps or less) could be installed where not readily accessible. Present Section 240-16 makes no provision for non-accessible supplemental overcurrent protective devices.

6. Section 250-23 will require that if utility distribution systems are grounded by the utility, grounded conductors shall extend to each service supplied. This new provision will provide a low-impedance grounding path in case of line-to-ground faults in service raceways or equipment.

7. As an alternate to grounding portable appliances, Section 250-45 will recognize two discreet insulations, which provide the double insulation principle used successfully in Europe for years.

8. Tables 250-94 to 250-95 will include grounding conductor sizes

for aluminum conductors. However, aluminum grounding conductors cannot be installed in earth or directly to masonry surfaces, and ground clamps for aluminum conductors will have to be approved for the purpose.

9. A new table will appear for supporting aluminum conductors in vertical raceways. Present table in Paragraph 300-19(a) will apply only to copper conductors.

10. In Article 310, a new THWN conductor will be recognized in sizes 14 to 8. This is a moisture- and heat-resistant thermoplastic wire similar in dimensions to TW.

11. Recognition will be given to vulcanized-rubber insulated conductors without an outer braid.

12. THW conductors will be approved in sizes larger than 500MCM.

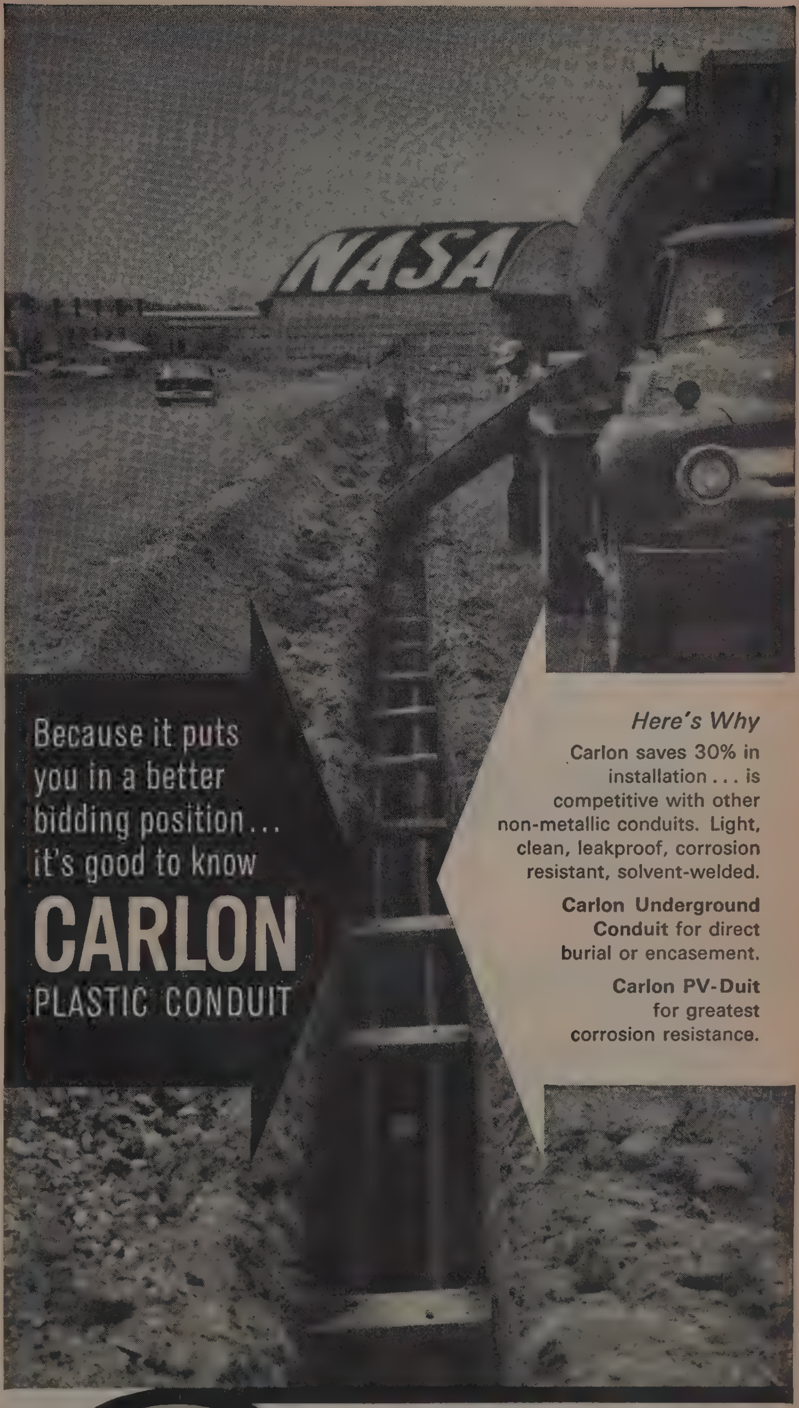
13. Present Article 334, titled "Armored Cable," will be renamed to read "Metal-Clad Cable." Two classes of cable will be MC for feeders and AC for branch circuits.

14. A new Article 331, titled "Aluminum-Sheathed Cable" will be included in Chapter 3. This type of cable is similar in construction to MI cable, except that each conductor in the cable is separately insulated.

15. Also in Chapter 3 will be new Article 347 for "Rigid Non-Metallic Conduit."

16. The third new article to be added to Chapter 3 will be Article 318—"Continuous Cable Supports." This article will include so-called cable trays, cable troughs, and

DISTINGUISHED Service Award was presented to Roy A. Palmer (standing, right) by Ned Fowler, President, Charlotte Engineers Club, at the Club's annual banquet held recently. Mr. Palmer was cited as "Lighting Pioneer, Fellow of the Illuminating Engineering Society" and for his "Achievement in advancing the profession of engineering and unusual service to this Club (Charlotte Engineers Club) and to the community at large; talented servant of civic and professional associations, education and the arts." Mr. Palmer has been with the Duke Power Company as illuminating engineer since 1928.



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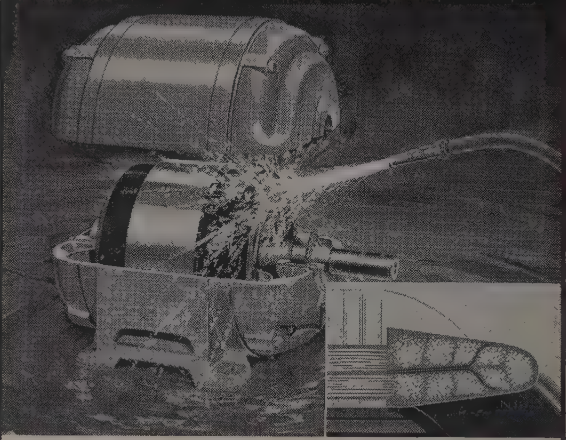

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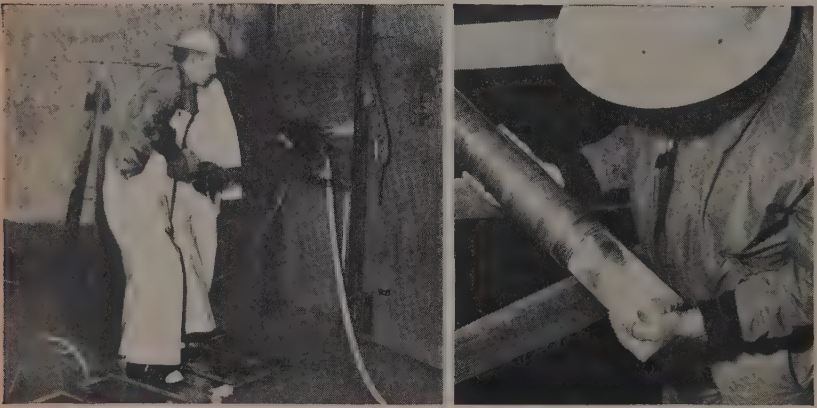

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cableways, and will define their uses and the type of cables that may be installed in them. Two manufacturers of these systems protested that the provisions, as proposed by CMP No. 8, did not go far enough to satisfy the recognized design practices of this system in the field. Also, an engineer for an insurance inspection organization requested additional code provisions to prevent misapplications of the product in the field.

17. Remaining on the docket for further study was the subject of maximum voltages permitted in buildings. Present code provisions limit such voltages to 15 kv, in general. A request, now under consideration, is to up the maximum rating to 35 kv. Utilities and engineers claim that new developments in dry-type transformer construction and high-voltage cable insulation will provide safe installations in buildings up to 35 kv. Since the present 15-kv limitation first appeared in the 1947 NEC, loads have increased to the point where higher voltage primary feeders seem advisable in the near future.

18. Article 725 will include provisions for grounding both Class I and Class II low-voltage circuits under the conditions specified in Part B of Article 250.

In addition to these major code proposals, a host of editorial changes have been recommended to provide a clearer understanding of NEC rules. Full details of all proposals will be given in the Preprint, which will be published about July 1, 1961. Copies will be available through the NFPA and various trade associations at that time.

MAINTENANCE procedures for electronic and control instruments are explained at 12th Plant Maintenance and Engineering Conference in Chicago by Roy E. Snider (standing) superintendent of maintenance and construction, A. C. Spark Plug Div., General Motors Corp., Flint, Mich. Session chairman was James W. Fulton (seated), electrical shop manager, R. J. Reynolds Tobacco Co., Winston-Salem, N. C.

HUMAN RELATIONS as it pertains to maintenance work prompted active audience participation when this subject was debated at the EMEA conference by Norman Watts, manager, West Coast Div., Florez, Inc., and by Erwin G. Wallenbrock, manpower development manager, Don Baxter, Inc.

Con Edison Reports On Wiring Program

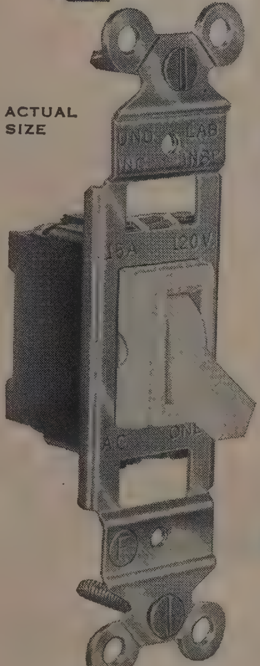
Electrical contractors rewiring buildings in New York City did a record $24 million business in 1960, according to a Con Edison report presented before 500 industry representatives on April 27 at the Biltmore Hotel.

J. O. Covington, manager of the Adequate Wiring Bureau for the Consolidated Edison Company of New York, asserted that "1960 has produced more rewiring than any previous year in each of three areas—private houses, non-residential buildings and apartment buildings." He added that over 50,000 houses and 6,000 apartment buildings have been rewired since Con Edison started its adequate wiring promotions eight years ago.

Mr. Covington announced that new promotional emphasis will be placed on the installation of air conditioning circuits when a building is being rewired. He noted that some contractors today do not add these circuits when doing a rewiring job.

The rewiring of private houses has increased steadily from 3,137 modernized in 1954, the first year of the program, to 10,403 in 1960, the first year in which more than 10,000 homes were modernized. By the end of 1960 the wiring was improved to a total of 49,880 private houses, and at the same time the wiring was modernized in 41% more nonresidential buildings than in any previous single year.

In his annual report to the industry, Mr. Covington also touched on the success of the first full year of the Medallion Home program.



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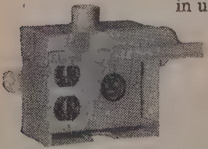
MODEL "50-15" solves power problems for Mobile Home Parks because it receives a wide variety of plugs. Offers a 50 amp. 250 volt 3-wire power receptacle, and a 15 amp. grounded duplex receptacle. Protected with two 50 amp. circuit breakers and fuse. Ample space for plug-in adapters when needed. Top hub and bottom knockouts facilitate overhead or underground connections. Completely weatherproof. Cover closes and can be padlocked when in use. Cords hang through rounded cord slots.



MODEL 34 offers 15 amp., 125 volt grounded duplex receptacle with 15 amp. fuse protection. Sixteen other "Hoffman" power outlets are available with choice of 15, 20, 30, 35 and 50 Ampere receptacles to fit your exact needs. Write us.

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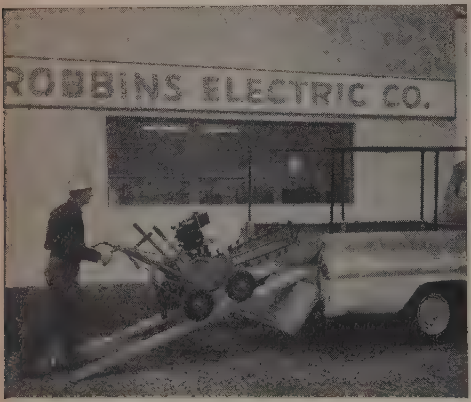

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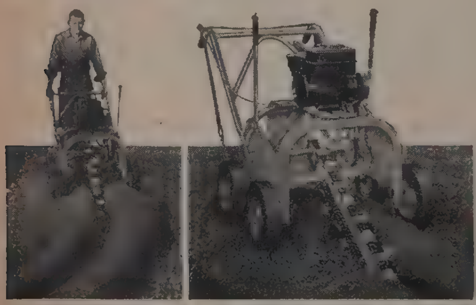

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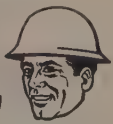

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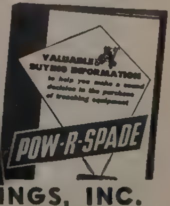

OR TEAR OUT THIS AD—ATTACH TO LETTERHEAD AND MAIL DIRECT

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ALL SET for resumption of estimating session at recent two-day electrical contractor seminar at University of Wisconsin are: J. W. Friess, Shaw Electric Co., Livonia, Mich.; and L. P. Kolon, Colonial Electric Co., Detroit. Seminar attracted contractors from six states.

Scholarships Given By JIBEI

The Pension Committee of the Joint Industry Board of the Electrical Industry gave 43 college scholarships to children of members of Local No. 3, International Brotherhood of Electrical Workers. The scholarships are worth $5,280 each.

The presentations were made at a breakfast held on May 20 at the Waldorf-Astoria Hotel. John W. Frommer, chairman of the Pension Committee presided.

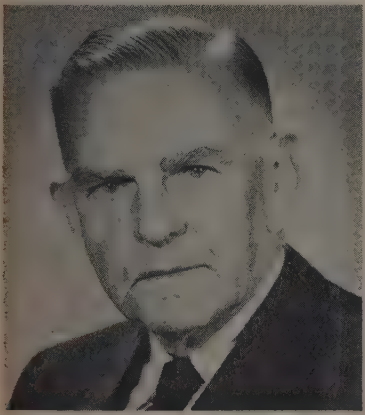
The scholarship program, which was started 13 years ago, is financed by the Joint Industry Board of the Electrical Industry. The value of the 43 awards, which are good for six years, is $227,040. Since the scholarship program was started the industry has paid out $1,500,000.

The scholarships will be used by the winners at Fordham University, New York University, Man-

ACTIVE in making the 24th Annual Upper Midwest Electrical Conference in Minneapolis a success were (L to R) Milo A. Miller, Electric Service Co., Blue Earth, Minn., and Norman Aune, Werner Electric Co., Brainerd, Minn.

hattan College, St. John's University, and Columbia University.

The principal speakers were John D. Rockefeller, 3rd, chairman, Lincoln Center for the Performing Arts and Harry Van Arsdale, Jr., business manager, Local Union No. 3, IBEW.



B. A. McDonald

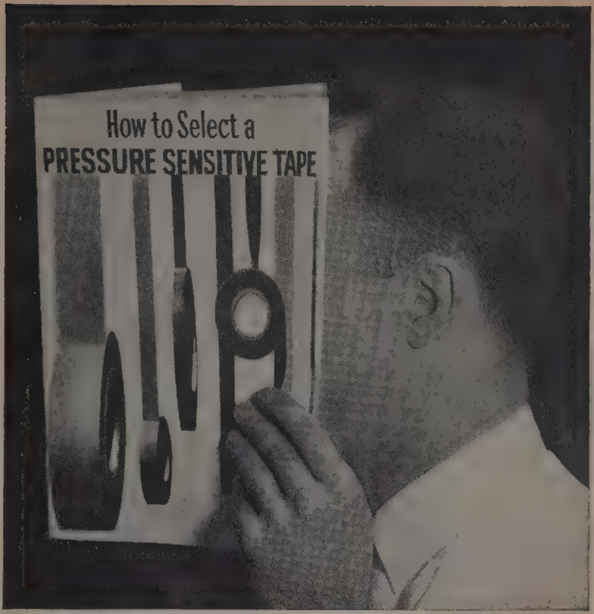
Bernard A. McDonald, for 11 years a consulting editor to *Electrical Construction and Maintenance*, and a regular contributor to "Questions on the Code" died May 10 after a brief illness. He was 70 years of age. Born in Rochester, N. Y., he attended schools in that city and was graduated from the University of Michigan with the degree of Bachelor of Science in Electrical Engineering.

He returned to Rochester to follow in the footsteps of his father, William H. McDonald, in the 90's Rochester's first electrical inspector for the Board of Fire Underwriters. In 1927 he was named Chief Electrical Inspector of the Rochester office of the New York Fire Insurance Rating Organization, remaining until his retirement in 1953.

He was active in the affairs of the International Association of Electrical Inspectors and was elected president in 1954. Following his retirement he became associate editor of the "News Bulletin" of that association. He was a member of the Executive Committee of the Genesee Chapter of IAEI.

He participated prominently in the development of the National Electrical Code through membership on the Electrical Committee of the National Fire Protection Association and in Code-Making Panels 5, 7 and 8.

He is survived by two sons, five daughters and 33 grandchildren.



Free booklet tells you what to look for in a pressure-sensitive tape

Here's a handy, new booklet that gives clear, concise answers to nearly any pressure-sensitive tape problem. It's based on Johns-Manville's long years of experience in the manufacture of tapes for electrical and industrial applications. It's called "How To Select A Pressure-Sensitive Tape," and tells you how to effect important economies; help speed production; eliminate knotty mechanical difficulties. It tells:

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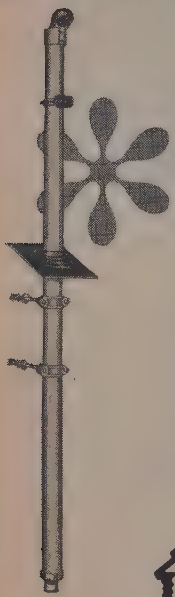

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EASA News

A partial answer to the shortage of labor in electrical apparatus service firms has been found in the training program being conducted for the State of Illinois by Still Electric Co., of Decatur, Ill. Operating one of seven vocational schools in the Decatur job Training Center, which is managed by the Illinois Division of Vocational Rehabilitation, owner Jerry Still says that more than 20 jobs await graduates, and that an equal number have been placed throughout the U. S. since the program began two years ago. At present, more than 80 trainees are undergoing an intensive 75-week course at Still Electric Co. Prospective employees are invited to write G. R. Still, Still Electric Co., 924 W. El Dorado St., Decatur, Ill.

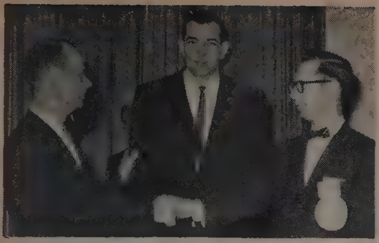
• • • •

Easa Easa, a West Hempstead, N. Y., lawyer, addressed the April meeting of the New York Metropolitan Chapter. Mr. Easa, of Middle-East origin, noted that in Greek his name means "strength." A successful candidate for his community's town council in last fall's election, Mr. Easa has capitalized on his name since Army days when it confused many a company clerk.

• • • •

In Boston, 40 members braved some rugged New England spring weather to attend a meeting of the New England Chapter on April 13 at Hotel Bradford. They approved the election of these officers: President, Robert O'Day, Controller Service and Sales, Boston; vice-president, W. Bruce Byrnes, Electric Motors, Inc., Fitchburg, Mass.;

ATTENDING the EASA Southwestern Chapter meeting in Lubbock, Texas, were: E. Arnold Tench, Tench Electric Motor Works, Shreveport, La.; Joe F. Hood, Carl Pons Electric Motors, Shreveport, La.; Frank J. Arriens, Frank's Electric, Bryan, Texas; Henry T. Poulan, Poulan Electrical Co., Monroe, La.; and A. O. Kleen, Electrical Service Engineering Corp., Austin, Texas.



RESIDENTIAL LIGHTING winners at Chicago Section, IES Lighting Competition are E. S. Reid (center), Contact Electric Supply Co., Chicago (2nd place for lighting a dining area); and Glenn Pracejus (right) accepting 1st place award to H. T. Sorenson, General Electric Co., Chicago, for his lighting of suburban residence. Competition chairman Don Ingwersen, Soila Electric Co., offers congratulations.

secretary, Hector Munro, New England Machine & Electric Co., Pawtucket, R.I.; treasurer, Jack Lynch, Lynch Electric Co., Wrentham, Mass.; and director, Kermit Pransky, Park Armature Co., Boston.

• • • •

The importance of keeping electrical equipment in check is always worth stressing, writes Julius Erdos, shop superintendent, Jackson-Bayley Electric Co., Canton, Ohio, in his company's publication. Mr. Erdos recommends that motors be kept clean and dry, that dry air be used to blow out windings and parts and that cover plates and gaskets be kept in good condition and be tightly fastened in place.

• • • •

James Previty Sr., Penn Electric Motor Co., Philadelphia, was elected president of Quaker City Chapter at a recent meeting. Other officers are: vice-presidents, George McDaniels, Kufen Electric Co., Warminster, Pa.; and Thomas Marino Jr., Marino Electric Co., Philadelphia; treasurer, Milt Eisenhardt, Merchantville, N. J., secretary, Frank Schaef, Smith of Philadelphia. George M. Wagner, Dick Fisher, Charles Sheelen, Charles Markley, Clarence Chandler, Don Willien, and Richard Lehr were elected to the executive committee.

• • • •

A meeting of electrical apparatus service shops in Ohio was held in Columbus on May 6 under the sponsorship of the state's EASA chapters, Central Ohio, Cincinnati, Cleveland, Miami Valley, and Youngstown. Speakers were: Burt Wyandt, Lima Electric Motor Co., Lima, Ohio; John Mayes, John C. Dolph Co., Monmouth Junction, N. J.; Don Osenbaugh, J. L. Hughes Electric Co., Columbus, Ohio; Bailey Price, National Electric Co., Columbus, Ohio; George Law, Reli-

pick your fish tape to fit your job

Have a tough wire fishing job? Don't fight it! Ideal fishing equipment makes any job smooth and easy.

Fairly straight and simple runs? All you need is an Ideal flat fish tape. These tough and flexible tapes are made of oil tempered spring steel. 1/8" and 1/4" sizes in 50, 100 and 200-foot lengths, with preformed hook at each end.

Save your hands! All Ideal tapes are available in the unique puller-reel that holds tape under tight control so it can't spring loose. This sturdy steel reel with smooth, rounded edges also gives you a man-size grip for pulling through the tough runs.

Hanging up on too many bends? Snake your way through all kinds of bends and els by adding an Ideal Flexible Leader to the front of your tape. Music wire spring wound around a 20" airplane cable makes pushing easy. Tested for 400 lb. pull. Eye takes up to six #10 wires. Other end screws tight into fish tape ball.

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COIL-FLEX. Here is a 25-foot version of the Ideal flexible leader. Use it as a fish tape to get through those impossibly tricky conduit runs. Goes around any bends without snagging or cutting. For long jobs, screw several together, or attach as an extra long leader for your regular fish tape.

NYLON INSULATED. Rugged Nylon insulation on round fish tape gives added protection when working in live panel boards and other "hot" equipment. For use in ¾" and smaller conduit. 50, 100, and 200-foot lengths with swivel ball on end.

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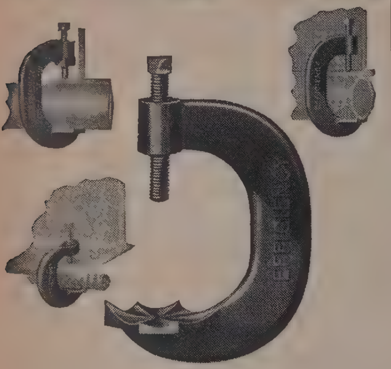
for GAS · CABLE
and AIR LINES



On Steel Construction, "Type F" hangers are best for carrying ½ to 2½ pipe and armored cable at any angle to beams.

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Standard Radius
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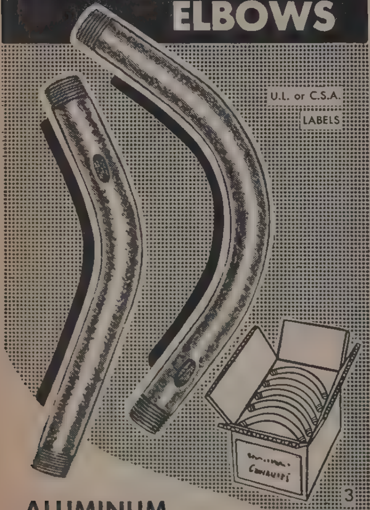

ALUMINUM
Black Enameled
Hot Dip Galvanized

CONDUIT NIPPLE MFG. CO.
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BUSY TOTING up score of contestants in Chicago Section, IES Lighting Competition, are judges: (L to R) Benjamin Benson, Benjamin Division, Thomas Industries; Edward Prims, Commonwealth Edison Company; and Carl Zersen, Chicago Lighting Institute.

ance Electric & Engineering Co., Cleveland, Ohio; Russ Paine, International Research & Development Corp.; and Stanley Meyers, A-C Supply Co., Akron, Ohio.

• • • •

John R. Watterson was elected president of Great Lakes Chapter at a meeting of the chapter April 17 in Detroit. On the same slate of officers were: O. B. Palmer and W. R. Lugar, vice-presidents; William Howard, treasurer; C. E. Smith, secretary; and J. Cohen, R. Templin, J. Bilicki and S. Graywall, directors.

• • • •

"A free exchange of information between the service shops and the manufacturers could be of benefit to both parties and would result in better service to the customer and a better quality in general throughout the country," EASA President-elect George Larsen said recently. A general feeling on the part of both manufacturers and service shops that warranty work practices should be "tightened up" was reported by Mr. Larsen.

• • • •

A member of the EASA Management Seminar team, Dr. Jack S. Wolfe, associate professor of marketing, St. Louis University School of Commerce and Finance, was the principal speaker at the spring meeting of Midwestern Chapter in Omaha, Neb., April 7-8. Shop owners were urged by Dr. Wolfe to stress human relations to their employees. "The employee your customer sees is *the company*," Dr. Wolfe said.

"Industry-wide standards for checking and testing insulation are practically non-existent," Richard Wareham, of Special Electric Co., Milwaukee, pointed out. "Each manufacturer, being human, uses and reports the tests that makes his product look best," he said.

CONSTRUCTING
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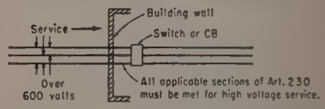
CODE RULES ON HIGH-VOLTAGE SERVICES


Building wall
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600 volts
All applicable sections of Art. 230
must be met for high voltage service.

Conductors and equipment for services rated over 600 volts between conductors must basically comply with applicable sections of Article 230 on services up to 600 volts. It should be noted that, for purposes of code application, secondary conductors, not the primary conductors, are regarded as constituting the service conductors to the building proper where: (A). Step-down transformers are located outdoors; (B) Step-down transformers are located in a separate building from the one served; or (C) Step-down transformers are located in the building served, in a transformer vault meeting code rules on construction of such vaults and under sole control of the supply company.

Chapters are broken down on the basis of types of equipment to facilitate ready reference: lighting equipment — motors and controllers — conductors — raceways — switches — overcurrent protective devices — switchboards and panelboards — transformers — capacitors and regulators — power sources — high voltage — signals and communications.

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DATES AHEAD

Illuminating Engineering Society—Regional Conference: Great Lakes, Sheraton-Gibson Hotel, Cincinnati, Ohio, June 19-20.

Electrical Apparatus Service Association, Inc.—28th annual convention, Jack Tar Hotel, San Francisco, Calif., June 11-14.

International Association of Electrical Inspectors — Chapter Meetings — **Virginia**, Hotel Roanoke, Roanoke, Va., June 12-13; **Northwestern Section**, Owyhee Hotel, Boise, Idaho, September 11-13; **Southwestern Section**, Hotel Del Coronado, Coronado, Calif., September 18-21; **Western Section**, Biltmore Hotel, Oklahoma City, Okla., September 25-27.

New York State Association of Electrical Contractors & Dealers—62nd annual convention, Whiteface Inn, Lake Placid, N .Y., July 2-7.

Western Plant Maintenance Show—Pan American Auditorium, Los Angeles, Calif., July 18-20.

National Assn. of Lighting Maintenance Contractors—National conference, Las Vegas, Nev., August 21-23.

Western Electronic Show and Convention—Cow Palace, San Francisco, Calif., August 22-25.

American Home Lighting Fixture Month—Sponsored by the American Home Lighting Institute, Chicago, Ill., September 1-30.

Rocky Mountain Electrical League—Fall Convention, Jackson Lake Lodge, Moran, Wyoming, September 10-13.

Industrial Electronics Symposium—Bradford Hotel, Boston, Mass., September 20-21.

Illuminating Engineering Society—National Technical Conference, Chase Park Plaza Hotel, St. Louis, Mo., September 24-29.

Industrial Building Exposition & Congress — New York Coliseum, New York, N.Y., September 25-28.

Third Virginia Biennial State-Wide Industrial Exposition—Victory Stadium, Roanoke, Va., September 27-30.

International Association of Electrical Leagues—25th Annual Conference, President Hotel, Atlantic City, N. J., October 4-6.

Western Building Industries Exposition—Great Western Exhibit Center, Los Angeles, Calif., October 7-10.

17th Annual National Electronics Conference — International Amphitheatre, Chicago, Ill., October 9-11.

National Electrical Contractors Association—Annual convention, Washington, D. C., October 9-14.

National Electrical Manufacturers Assn.—Annual meeting Traymore Hotel, Atlantic City, N. J., November 13-17.

Sixth National Electrical Industries Show — New York Coliseum, New York, N. Y., March 11-14, 1962.

Electrical Apparatus Service Association—Convention, Conrad-Hilton Hotel, Chicago, Ill., June 3-7.

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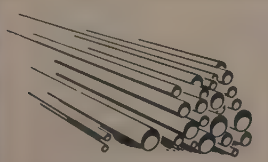

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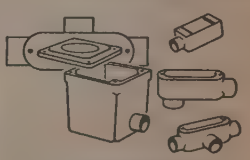

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Among the Manufacturers

Headquarters Announcements

Sierra Electric Corp. has purchased the **Square D** low-voltage system for home and commercial lighting and power control. Manufacturing will be moved from Cedar Rapids, Iowa to Gardena, Calif., plant by July 1.

The name of the **Wakefield Co.** was changed to Wakefield Lighting Div., Wakefield Corp., Vermilion, Ohio; and the name of **The Art Metal Co.** was changed to Art Metal Lighting Div., Wakefield Corp., Cleveland, Ohio.

The Mummert-Dixon Co., Hanover, Pa. has announced the acquisition of the Keystone Aerial Ladder Div. from the Delta-Star Electric Div., H. K. Porter Co., Philadelphia.

General Electric Co., Schenectady, N. Y.—Hans R. Wallrath, manager of construction industry sales.

Oak Manufacturing Co., Crystal Lake, Ill.—Edward D. Chalmers, vice president of engineering; Edward J. Mastney, vice president of advanced engineering and manufacturing.

H. K. Porter Co., Inc., Pittsburgh, Pa.—Shannon C. Powers, vice president and general manager, National Electric Div.

Emerson-Pryne Co., Pomona, Calif.—Phillip D. Pryne, president; E. F. Kelly, chairman of the board; Ralph Pryne, director.

Corning Glass Works, Corning, N. Y.—Amory Houghton, chairman of executive committee; William C. Decker, chairman of the board and chief executive officer; Amory Houghton, Jr., president; Thomas S. Wood, Jr., vice president.

Edwards Co., Inc., Norwalk, Conn.—Frank T. Franco, advertising coordinator.

General Electric Co., Niles, Ohio—A. J. Gizzi, manager of manufacturing of all operations of the Conduit Products Dept. at Niles, Ohio, New Kensington, Pa. and Bridgeport, Conn.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Roy M. Casper, general manager, Power Equipment Div.

Westinghouse Electric Corp., Pittsburgh, Pa.—Carlisle P. Myers, vice president.

John J. Nesbitt, Inc., Philadelphia, Pa.—William D. Widerman, vice president of sales.

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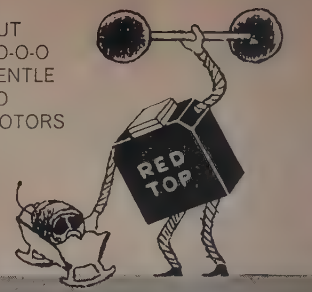

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Sorensen & Co., South Norwalk, Conn.—George B. Estes, manager of company and other units of the Industrial Operations of Raytheon Co.'s Commercial Apparatus and Systems Div.

Stanco Mfgs. & Sales, Inc., Santa Monica, Calif.—William S. Gaskill, general sales manager.

Sylvania Electric Products Inc., New York, N. Y.—Gene K. Beare, president.

Luxo Lamp Corp., Port Chester, N. Y.—Sam F. Blake, Jr., vice president of eastern sales.

Hubbard & Co., Chicago, Ill.—John C. Monday, vice president and general manager, Hapco Div.

Joy Manufacturing Co., St. Louis, Mo.—Robert D. Spencer, product manager, Electrical Products Div.

Pendar, Inc., Van Nuys, Calif.—Joseph H. Schellman, president; C. E. Fisher, chairman of the board.

Omark Industries, Inc., Portland, Ore.—Edward P. Skralskis, executive vice president; Howard G. Cutright, vice president of marketing.

Pacific Semiconductors, Inc., Lawndale, Calif.—Robert S. Putnam, manager of industrial relations.

Kennecott Copper Corp., New York, N. Y.—Frank R. Milliken, president.

The Fafnir Bearing Co., New Britain, Conn.—Keith T. Middleton, president; Clarence G. Rosenweig, vice chairman of the board.

Borg-Warner Corp., Chicago, Ill.—Douglas Mueller, director of public relations and advertising.

Shallcross Mfg. Co., Selma, N. C.—Robert E. Johnson, vice president and sales manager.

Keystone Mfg. Co., Warren, Mich.—John C. Woodle, vice president of sales.

The Standard Transformer Co., Warren, Ohio—Ted E. Gaty, sales manager.

Burndy Corp., Norwalk, Conn.—Herbert H. Rogge, director and chairman of the Executive Committee.

The Electric Autolite Co., Toledo, Ohio—Earl R. Fiene, vice president and director of sales.

Anaconda Wire and Cable Co., Hastings-on-Hudson, N. Y.—Robert E. McIlvane, manager, Communications Products Div.

Soundolier Mfg. Co., Inc., St. Louis, Mo.—Ted Beyert, general manager of design and research; Cliff Bright, sales manager.

Permacel, New Brunswick, N. J.—P. R. Trailer, sales promotion training director.

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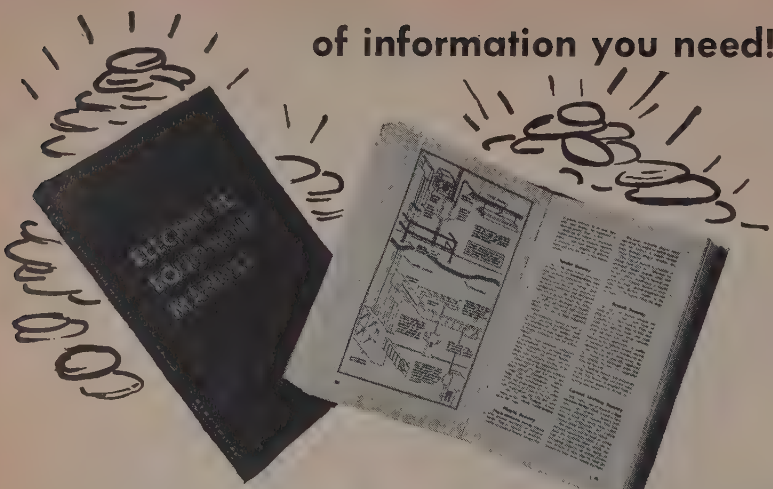

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Owatonna Tool Co., Owatonna, Minn.—S. L. Richmond, sales manager, Tools and Equipment Div.

Regional Appointments

NEW ENGLAND

Thiel Tool & Engineering Co., Inc.: Kenneth McIsaac, Quincy, Mass., representative for pole line hardware line.

MIDDLE ATLANTIC

Owatonna Tool Co.: Arthur Kreager, district sales manager for West Virginia and western Pennsylvania, Tools & Equipment Div.

Tork Time Controls, Inc.: Leslie A. Osterman, Skaneateles, N. Y., representative in upstate New York territory.

C & S Products Co.: Arthur F. Schultz, representative for Semper-Seal in New York state, from Albany west.

Johns-Manville Sales Corp.: Robert D. Wisbon, sales representative for Philadelphia territory.

Reynolds Metals Co.: Charles R. Wentz, manager of Chester, Pa., plant.

SOUTH ATLANTIC

Ridge Tool Co.: Gordon M. Henderson, salesman for state of Florida.

The Wakefield Co.: Gerald Preacher, Lexington, S. C., representative for entire state.

Blackhawk Industries: LeRoy P. Spoon, Charlotte, N. C., representative for the Carolinas.

Johns-Manville Sales Corp.: Charles F. Briggs, sales representative in the Atlanta, Ga., territory.

Thiel Tool & Engineering Co., Inc.: Charles McFee, Atlanta, Ga., representative for pole line hardware line.

EAST CENTRAL

Tork Time Controls, Inc.: Arthur L. Pickens, Mayfield, Ky., representative for Indiana and Kentucky.

Owatonna Tool Co.: James Rainey, district sales manager for Illinois (except Chicago), Tools & Equipment Div.

Bohn Aluminum & Brass Corp.: B. A. Jared, sales representative for Indiana sales district with headquarters in Muncie, Ind.

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General Blower Co.: Robert McAndrews, Cincinnati sales agent.

Westinghouse Electric Corp.: A. J. Gilbreath, midwestern regional sales manager for Air Conditioning Div., located in Chicago.

Thiel Tool & Engineering Co., Inc.: Riecher Electrical Sales, Detroit, representative for pole line hardware line.

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Johns-Manville Sales Corp.: Thomas D. Hoffstatter, sales representative in the Tulsa, Okla., territory.

Harvey Aluminum: Haizlip Jobber Suppliers, Inc., Kansas City, Kan., sales representatives for rigid conduit in Kansas, Nebraska, western Iowa, western Missouri.

The Bryant Electric Co.: John R. Commons, sales representative for Houston territory.

Thiel Tool & Engineering Co., Inc.: Waterman & Waterman, St. Louis; Bassett-Eischen, Omaha; Texas Sales Rep., Houston; and Nulik-McCormick Co., Kansas City, representatives for pole line hardware line.

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Thiel Tool & Engineering Co., Inc.: The Darger Co., Salt Lake City; Keeler-White Co., San Francisco; Gordon Laurson & Son, Albuquerque; and M. Levin, Portland; representatives for pole line hardware line.

Pendar, Inc.: A-F Sales Engineering Inc., Pasadena, Calif., sales representative in southern California.

C & S Products Co.: John T. Hill and William M. Rambo, San Gabriel, Calif., representatives for Semper-Seal for southern California and Arizona.

The Bryant Electric Co.: Bryon L. Waters, sales representative for Los Angeles territory.

General Electric Co.: Wallace Ross, northwest region electric heating specialist, Electric Comfort Heating Section, with offices in Seattle, Wash.

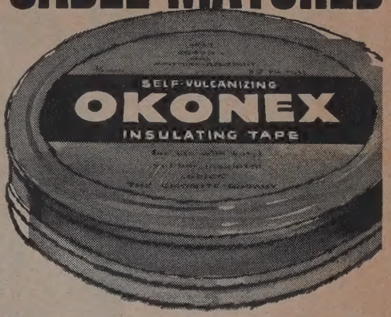
Luxo Lamp Corp., Robert Rubin, manager of the Western Div.

Blackhawk Industries: Frank E. King and Robert Sutton, Electro-rep, Inc., San Francisco, agents in northern California.

Harvey Aluminum: Allen B. Carpenter Co., Denver, Colo. and Salt Lake City, Utah, sales representative for rigid conduit.

Black & Decker Mfg. Co.: Dale C. Spohrer, sales representative in the Los Angeles district, Consumer Products Div.

CABLE-MATCHED



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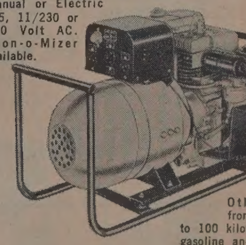

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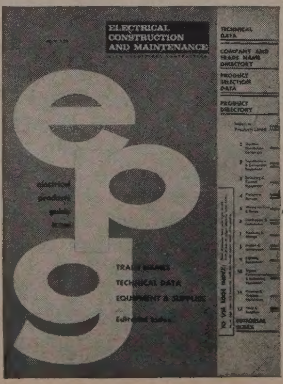

• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

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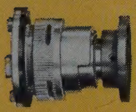
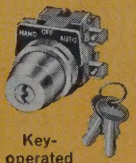

Mushroom Button

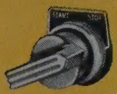
Extended Guard Button

Selector Switch

Coin-operated Selector Switch

Selector-Push Button

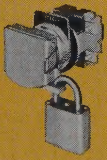

Key-operated Selector Switch


Selector Switch with Gloved Hand Operator

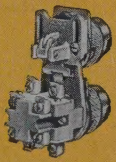
Illuminated Push Button

Push-to-Test Pilot Light

Stop Button Lockout

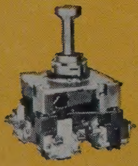

Start Button Lockout

Selector Switch Padlock Attachment


Maintained Contact Attachment

Wide Range of Contact Blocks

Enclosures and Assembled Stations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3-Position Master Switch

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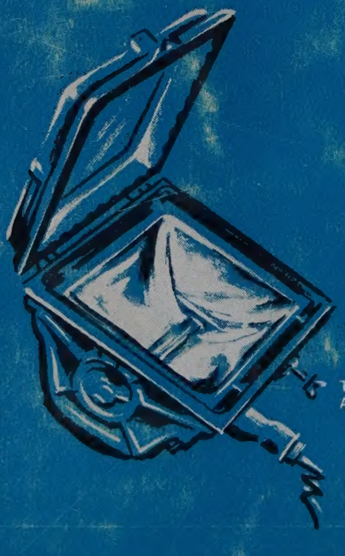

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